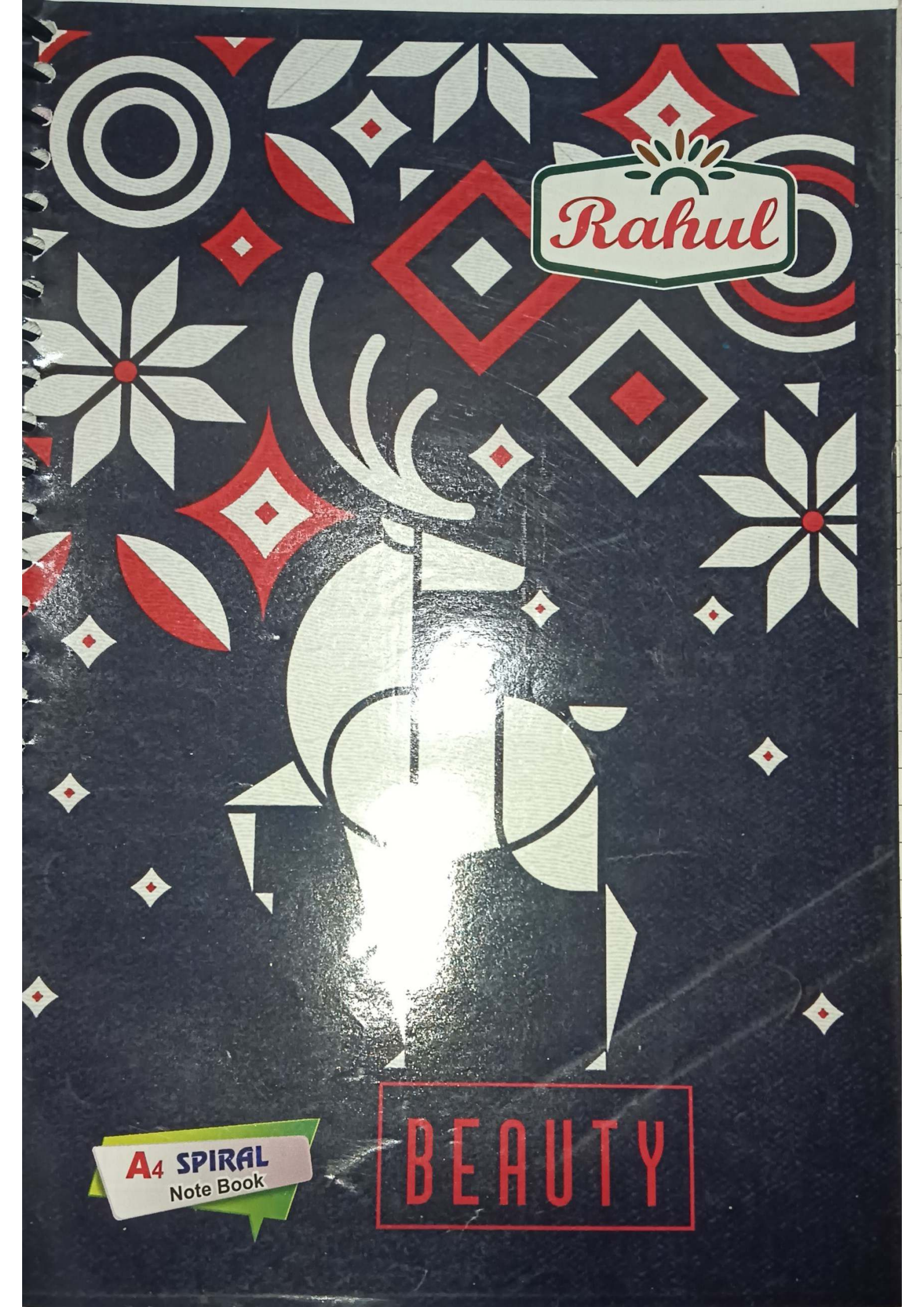




Rahul

A4 SPIRAL
Note Book

BEAUTY

BOTANY

class ÷ 11th

Page No. : _____
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Let's learn

Cell ÷ The Unit of Life

Page No. : _____

Date : _____

* Introduction

Animate	Inanimate
• cell is present	• Cell is absent
• Living	• Non-living

- All organisms are composed of cell. Some composed of a single cell and are called unicellular organisms while others, like us composed of many cells and are called multicellular organism.

* Cell

- Cell is the fundamental structural and functional unit of all living organisms
- Anything less than a complete cell doesn't ensure as living.
- Unicellular organism are capable of
 - (i) Independent existence
 - (ii) Perform the essential function of life

• DNA $\div$ Deoxyribonucleic acid

• Ribosomes are macromolecular machines that perform

protein synthesis.

* Minimum requirements for cell

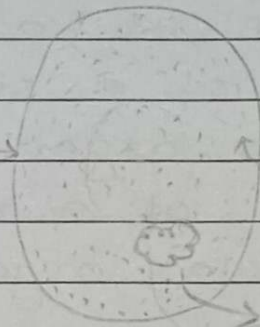
(i) cytoplasm (ii) DNA (iii) Ribosome (engine of cell) (iv) cell-membrane (plasma-mem)

* Types of cell

There are two types of cell

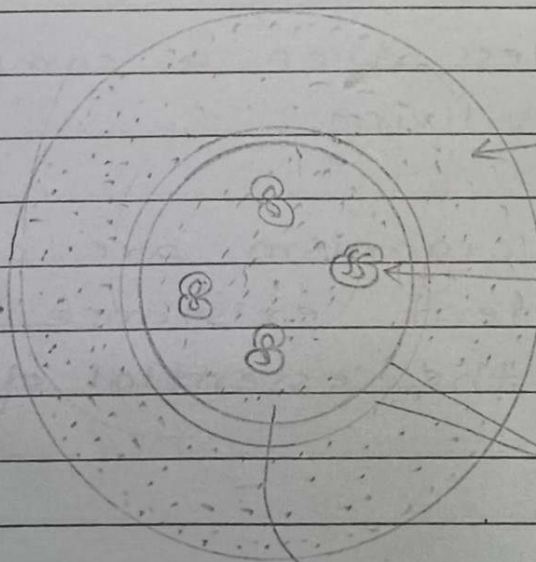
(1) prokaryotic cell (bacteria)

• 1st came on earth



ds-DNA, circular
& naked

(2) Eukaryotic cell (plant, animal etc)



cytoplasm

ds-DNA, linear
& closed

2-nuclear
membrane

nucleoplasm

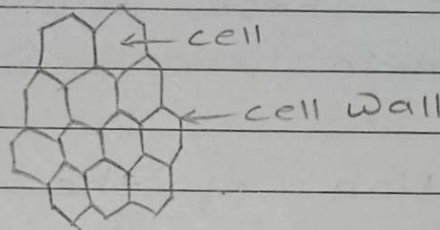
- highly coiled DNA is called chromosome.
- loosely coiled DNA is called chromatids.

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- cytoplasm + nucleoplasm = protoplasm

* Robert Hooke

Cell (dead cell) was discovered by Robert Hooke.



Honey-comb like structure

- A thin section (slices) of cork of oak tree was observed under his microscope.
- He saw honey comb-like structure, each structure was called cell (cellula).
- He published honey-comb like structure of cell in ~~A~~ all over the world in his book micrographia.

* Anton van Leeuwenhoek

He was the first person who saw and described the living cell under his improved microscope in 1674.

- He first saw cladophora algae, after this he saw RBC, sperm cell, bacteria, protozoa.
- He observed moving objects under his microscope which are called animalcules. These included protozoa and bacteria.
- The invention of the microscope and its improvement leading to the electron microscope. Electron microscope revealed all the structural details of the cell.

* Robert Brown

[Robert Brown discovered nucleus (dense membrane structure) in 1831

- [Nucleus is the master of cell and cytoplasm is the main arena of cell (cellular -activity)

- Cytoplasm is a semi-fluid matrix (jelly like)

* Cell theory

- M. Schleiden (German Botanist)

He stated "Plant is made of plant cell, these cells constitute plant tissue."

- T. Schwann (British Zoologist)

He studied animal cell and stated

(i) Animal body is made of animal cells, these cells constitute animal tissue.

(ii) Animal cell has a thin delimiting membrane called plasma-membrane.

- He also studied plant and stated "plant cell has a unique character that is presence of cell wall."

- Both M. Schleiden & T. Schwann gave cell theory (1838-39)

(i) Cell is the fundamental basic unit of life

(ii) Body of organism are made of cells and their products.

- cell theory doesn't apply on virus (non-cellular life)

- Cell theory doesn't explain how ^{new} cell divides formed

- R. virchow

He gave the idea of cell division (1855)

He said "Existing cells arise from pre-existing cells (Omnis cellula e cellula)"

- Final cell theory

(i) All living - organisms are composed of cell and products of cells.

(ii) All cells arise from pre-existing cell.

* Common structure b/w prokaryotic cell and eukaryotic cell (similarities)

(i) Cytoplasm = Semi-fluid matrix, main area of cellular activity, various chemical reactions occur inside the cytoplasm to keep the cell in living state.

(ii) plasm-membrane ÷ A thin outer boundary around cytoplasm

(iii) DNA ÷ Genetic-material

(iv) Ribosomes ÷ Non-membraned

★ Different b/w Eukaryotic and prokaryotic cell

Prokaryotic cell

Eukaryotic cell

- | | |
|---|---|
| <ul style="list-style-type: none"> • Nucleus is absent. Instead they have a nucleoid region in the cell • DNA is not covered by nucleus-membrane present. (naked - DNA) • Nucleus-membrane is absent • Double - DNA, circular ^{naked} (closed) • Doesn't form chromosomes | <ul style="list-style-type: none"> • Nucleus is present • DNA is covered by nucleus-membrane • Nucleus membrane is present • Double - DNA, linear (open) • Formed chromosomes • DNA with histone protein • Ribosomes ÷ Both 80s (inside cytoplasm) and 70s (inside mitochondria & chloroplast) |
|---|---|

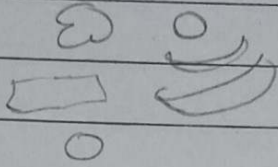
- Some bacteria have extra DNA called ~~plasti~~ plasmid DNA.

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- DNA without histone .
 - in the place of histone polyamines (ex: mitochondria & found chloroplast) are present
- Ribosomes : only 70s . larger cell (10 to 20 μm) types (smaller) inside cytoplasm . Slow division of cell
- No single and double . Animal , plant etc membrane bound organell
- Smaller cell (^{maxi} 3 to 5 μm)
- fast division of cell
- only bacteria are included
- * Shape and size of cell
 - Mycoplasma (0.3 μm)
 - Typical bacteria/ prokaryotic cell (1-2 μm)
 - Typical eukaryotic cell (10 to 20 μm)

- Red blood cell



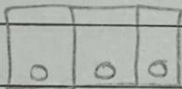
- round and ~~bicox~~ biconcave
- 7.0 μm in diameter

- White blood cell / Leucocyte

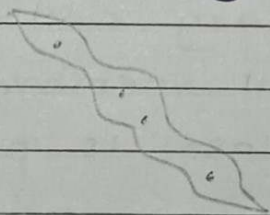
- irregular or amoeboid (am)

- Columnar epithelium

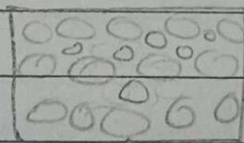
- long and narrow



- A tracheid (elongated) → A xylem cell

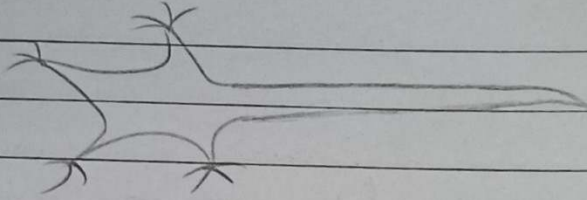


- Mesophyll cell → A cell of mesophyll tissue, which is found in leaves.



mesophyll cell

- Nerve cell (branched and long)



- ✓ Smallest cell ÷ Mycoplasma (also known as pleuropneumonia like organism)
- ✓ Largest isolated animal cell ÷ Ostrich's egg
- ✓ Largest plant cell ÷ Xylem fibre or sclerenchyma fibre
- ✓ Largest animal cell ÷ Neuron (nerve fibre)
- Typical plant cell (onion-peel cell) ÷
As outer boundary cell-wall is present and within it cell membrane is present (inner to it cytoplasm is present)
- Human cheek cell (typical animal cell) ÷
As outer boundary only cell-membrane^e

* Characteristics of prokaryotic cell (Bacterial cell)

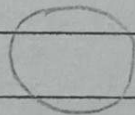
All useful bacteria + all harmful bacteria + cyanobacteria (Blue green algae, BGA)
~~BGA~~ + mycoplasma $\neq$ ppLO₂

[All prokaryotic cell have cell-wall except mycoplasma

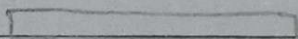
- Mycoplasma hasn't cell-wall, no definite shape. So it's called joker organism.
- The size and shape of prokaryotic cell is very differ.
- Prokaryotic cell is smaller than eukaryotic cell and divide rapidly.

^{V.I}
 R-~~✓~~ Four basic shape of bacterial cell

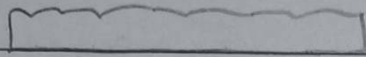
(1) Coccus $\rightarrow$ Spherical, oval shape



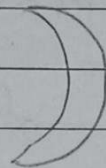
(2) Bacillus $\rightarrow$ elongated - cylindrical shape, rod like



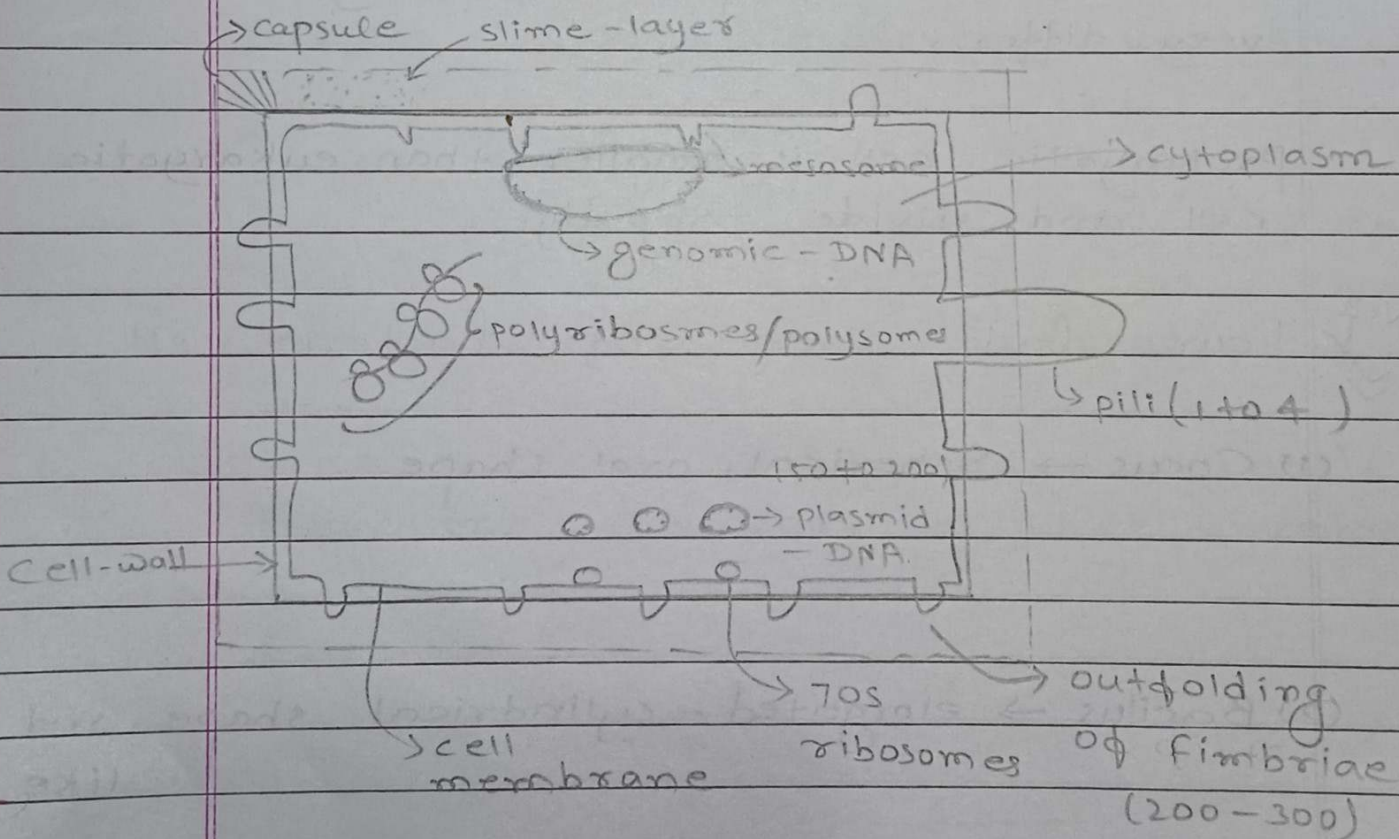
(3) Spirilli $\rightarrow$ spiral coil shape



(4) Vibrio $\rightarrow$ Comma shape



Vo. I * Detail of typical bacteria (prokaryote)



- Slime-layer + Capsule = Glycocalyx
- Glycocalyx + Cell-wall + Cell-membrane $\Rightarrow$ Cell-Envelope
- Above the cell-wall there is one layer that could be hard (capsule) or loose (slime-layer)
- Extra DNA (plasmid-DNA) found in some bacteria
- plant $\rightarrow$ Autotrophic (starch-reserve food material in cell)
- Animal, fungus and majority of bacteria $\rightarrow$ Heterotrophic, glycogen & starch in cytoplasm as dead structure (inclusion body)
- Glycocalyx
Cell-wall
Cell-membrane
 - Cell-Envelope
 - (chemically complex structure)
- They are tightly bond
- They form protective unit
- They give protection to bacterial-cell.

I * Bacterial Glycocalyx

- Glycocalyx is the outer layer of bacteria
- Made of carbohydrate
- Function of glycocalyx
 - (i) Glycocalyx/capsule hides bacteria from WBC
 - (ii) Glycocalyx helps the bacteria to attach host surface (skin)
- Smooth bacteria (pathogenic, S-strain)
→ Capsulated with glycocalyx/capsule
- Rough bacteria (non-pathogenic, R-strain)
→ Without capsule

I * Types of bacterial glycocalyx

There are two types of glycocalyx (on the basis of thickness and chemical composition)

- (i) Slime layer (ii) Capsule

(1) Slime layer

- Thin loose sheath
- Made of muco-polysaccharide
- Easily removable

(2) Capsule (sticky)

- Thick layer
- Made of muco-polysaccharide + protein
- Not easily removable

VoT

- * Prokaryotic cell-wall and its function
 - 2nd layer of bacterial cell

• Function

- (i) provide proper shape to the bacterial cell
- (ii) protects bacteria from bursting and collapsing.

- Cell-wall is made of peptidoglycan chemical (mucin/muco-peptide) + phospholipid + protein

- Main chemical compound is peptidoglycan (in the form of network)

↓

Peptidoglycan

2 - small protein

2 - Carbohydrate

(i) Tetrapeptide

→ ○—○—○—○ (amino-acid)

(i) NAG → N-acetyl
glycosamine

(ii) pentapeptide

→ ○—○—○—○—○

(ii) NAM → N-acetyl
muramate

glycosidic linkage

NAG

NAG

NAG

NAM

NAM

NAM

NAG

NAG

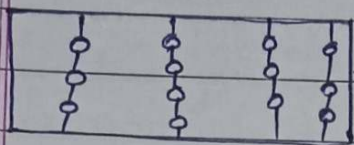
NAG

network
of
Peptido-
glycan

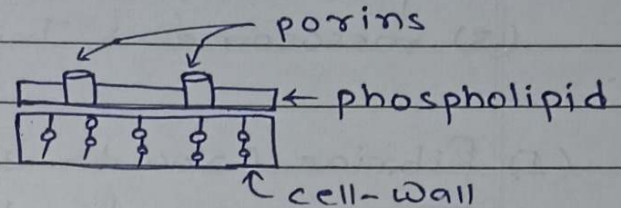
- Penicillium (1st discovered antibiotic)
- Stop (inhibits) the cross-linkage of peptidoglycan (network of peptidoglycan is not formed) and bacteria are killed

* Types of bacteria (on the basis of structure of cell-wall)

(1) Gram +ve bacteria (2) Gram -ve bacteria



→ cell-wall



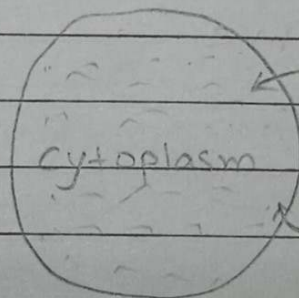
↑ cell-wall

- | | |
|--|--|
| <ul style="list-style-type: none"> • single layer + thick • more amount of peptidoglycan (80%) • receive gram stain | <ul style="list-style-type: none"> • 2 layer + thin • less amount of peptidoglycan • can't receive gram stain • porins = protein-channel |
|--|--|

V.I

* Cell membrane/plasma-membrane of bacterial cell

Similar in structure and function from eukaryotic cell-membrane, like eukaryotes, the cell membrane is selective permeable.



→ H₂O = semi-permeable

→ H₂O + selected molecule = selected permeable

- Cell membrane of bacteria forms three structure :-

- (1) fimbriae
 - (2) pili
 - (3) mesosome
- out-folding
- Infolding

(1) Fimbriae (200 to 300)

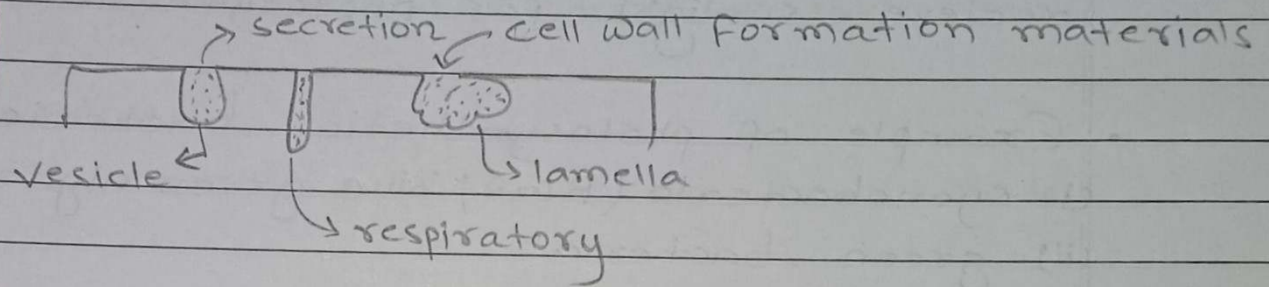
- They are bristle like structure, sprouting out of cell.
- Function :- Attachment of bacteria to the host surface (skin) and rock in stream.

(2) Pili (1 to 4)

- long and tubular structure
- made of a special protein → pilin
- plasmid-DNA + pili are present in gram -ve bacteria
- function
Help to transfer plasmid DNA from gram -ve to gram +ve

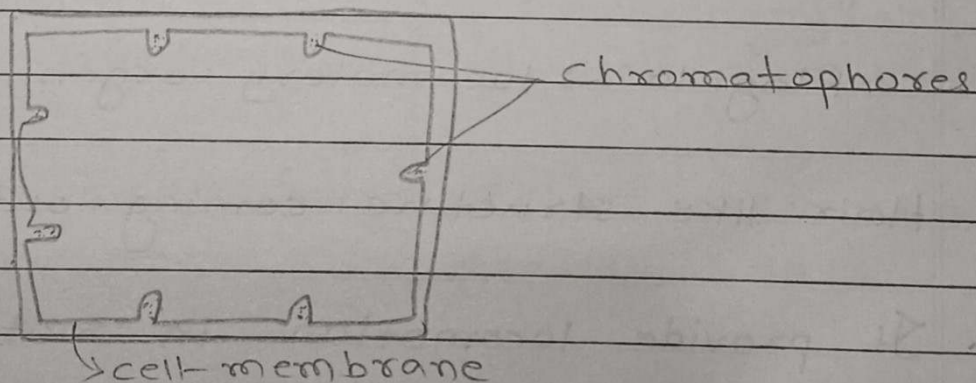
(3) Mesosomes (infolding of cell-membrane)

Convolutd structure, present in three forms



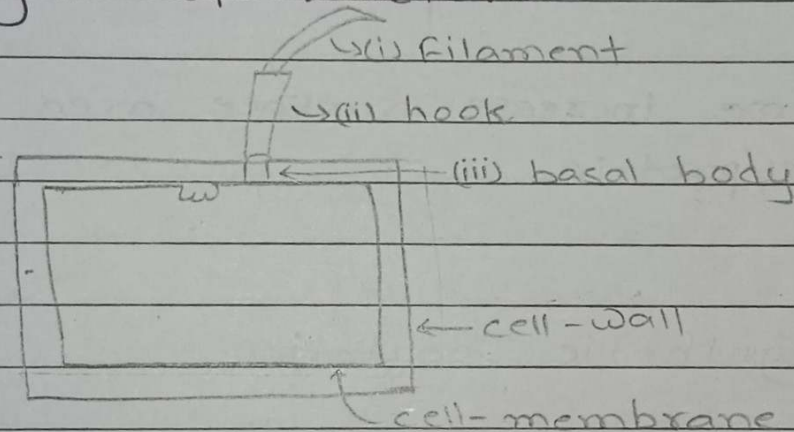
- Function: secretion (outside cell)
cell-wall formation
DNA-replication } → During binary fission
- Mesosome increase surface area for more enzymes/protein.

* photosynthetic bacteria



- Chromatophores (chloroplast of bacteria)
 → Extension (infolding) of plasma-membrane into the cell, filled with pigment to receive sunlight for photosynthesis.
- Example of photosynthetic bacteria
 - (i) cyanobacteria (BGA) blue green algae
 - (ii) green bacteria
 - (iii) purple bacteria

* Flagella of bacteria



Flagella → locomotory organ

- Hair like structure coming out from cell.
- It provide locomotion in motile bacteria, flagella is absent in non-motile bacteria.

• There are three parts of flagella.

(a) Filament

→ long extended part of outside cell

(b) Hook

→ It connect filament to basal body

(c) Basal body

→ Embedded inside cell wall and cell membrane to provide strength

* Different b/w nucleoid DNA & plasmid DNA

Nucleoid DNA

plasmid DNA

• In all bacteria

• In some bacteria

• larger, single ds-circular. small, many (20-200) ds-DNA, naked (in cytoplasm) circular DNA & naked

• Called a single bacteri. Extra chromosomes/extra-al chromosome (genomic DNA)

genomic DNA

• have all genes needed for survival of bacteria

• have genes ~~to~~ for antibiotic ~~resistant~~ ~~it~~ co resistant, it confer unique character to the bacteria.

- Nucleoid DNA = false primitive nucleus / Incipient nucleus / genophore

• plasmid - DNA with foreign DNA results bacterial transformation

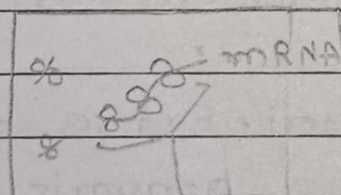
* Ribosomes, Inclusion bodies and Binary Fission in prokaryotic cell

• Ribosome

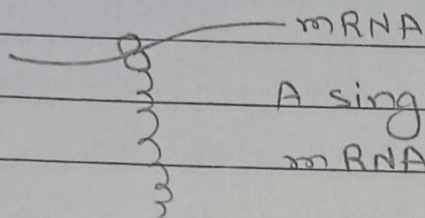
In bacteria 70s ribosomes (smaller than 80s) found.

• Size of 70s ribosomes → 15nm to 20nm
width length

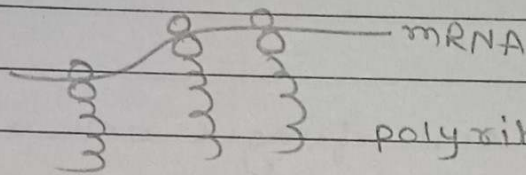
- 70s ribosomes → larger subunit (50s)
→ smaller subunit (30s)



- **Polyribosomes** - When many ribosomes are present in one mRNA are called polyribosome



A single 70S ribosomes on a single mRNA, protein (one copy)



polyribosome on a single mRNA

protein (multiple copies)

- **Inclusion body**

All structure inside cell which are dead (non-living), non-membrane (membraneless), and freely present in cytoplasm are called inclusion bodies.

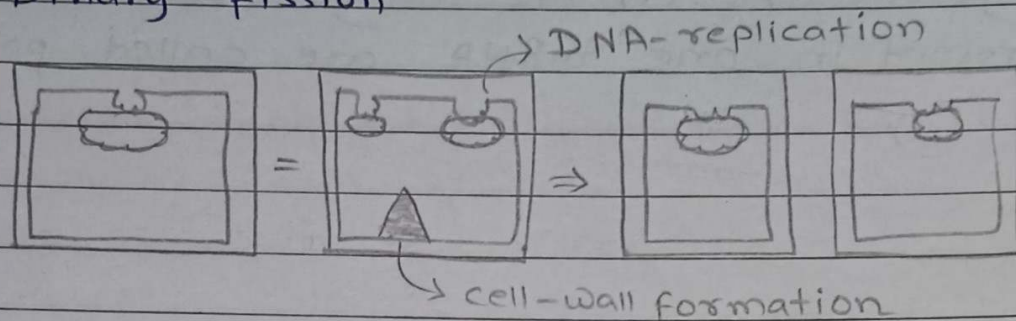
eg: • Reserve food material

(i) glycogen granule

(ii) Cyanophycean granule

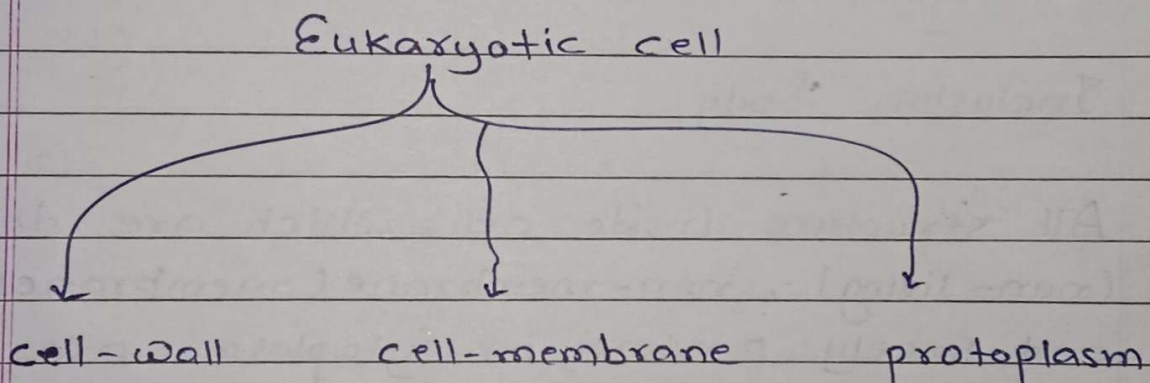
- phosphate granule (volutin-granule)
- sulphate granule
- gas vacuole

• Binary fission

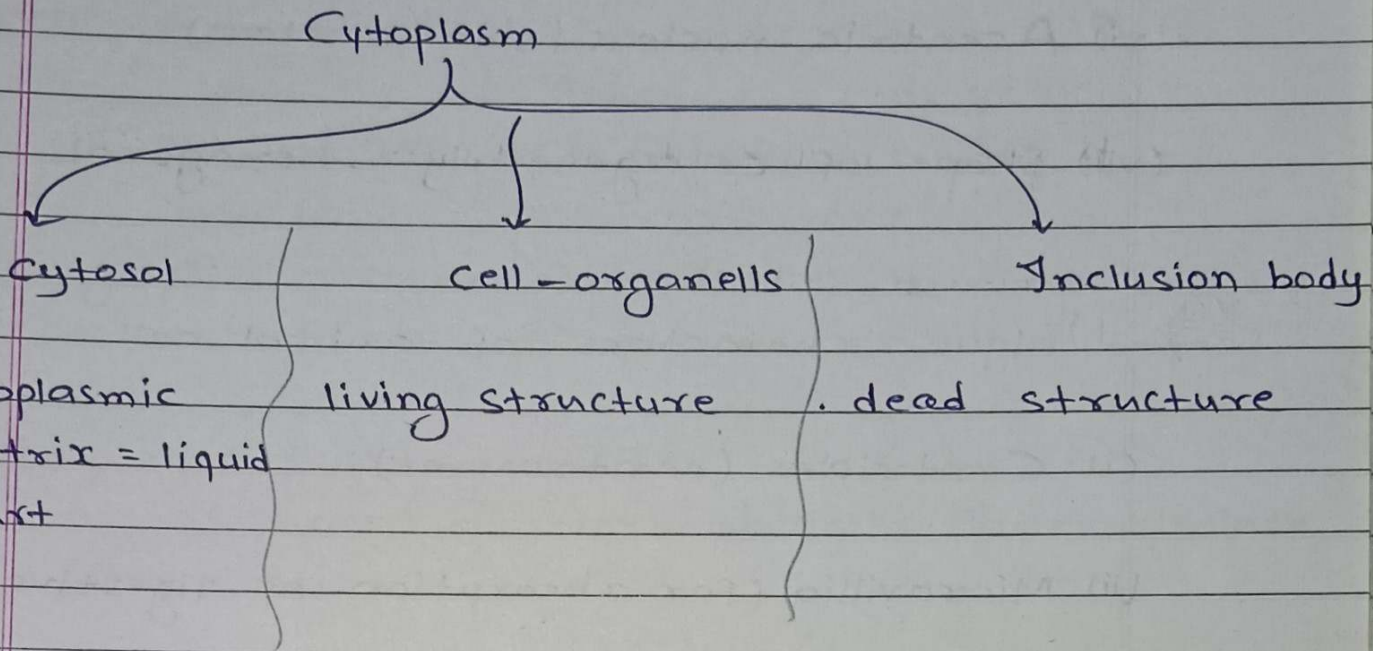


* Eukaryotic cell

plant cell, animal cell, fungus cell and protista cell.



- protoplasm
- (i) nucleus
 - (ii) DNA
 - (iii) RNA
 - (iv) protein and enzyme



V.V.I

* Unique characters of plant

(i) cell wall

(ii) middle lamella → cement ~~to~~ two adjacent plant cell

(iii) plasmodesmata

→ Connect two adjacement _ plant cell

(iv) plastids

- chloroplast (green)
- chromoplast (colourful)
- leucoplast (colorless)

(v) A large central vacuole ^{is present} that covers 90% area of plant cell

(vi) Acentric nucleus (side nucleus)

(vii) Shape of cell generally hexagonal

V.I
* Unique characters of animal cell

(i) Centrioles (centrosome)

(ii) Microvillia (for absorption of digestive food)

(iii) Gap junction - Connection b/w two adjacent animal cell.

(iv) Centric (in centre) nucleus

(v) polygonal shape of animal cell

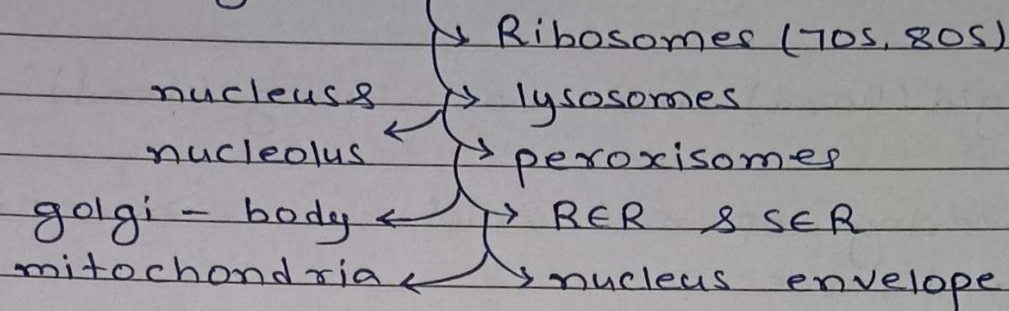
* Common - character for plant and animal cell

(i) Cell-membrane

(ii) protoplasm

cytoplasm + nucleoplasm

(iii) Cell-organelle



(iv) Cytoskeleton

microfilament + microtubules + Intermediate filaments

- * - Cell wall

Cell wall present in :-

(1) plant (cellulosic cell-wall)

cellulose + Hemicellulose + pectin + proteins

(2) Fungus (chitinous cell wall)

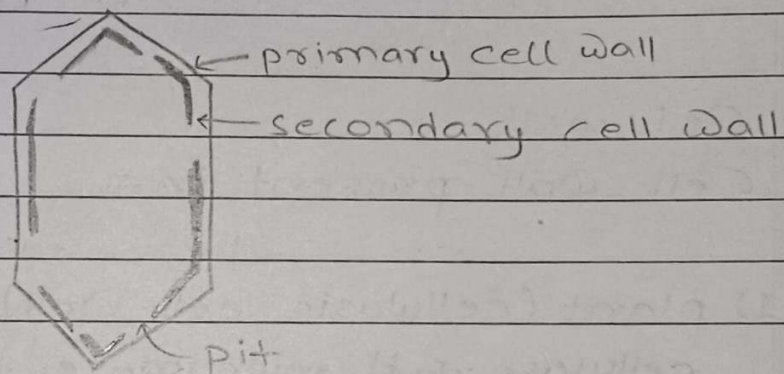
chitin (polysaccharide/carbohydrate)

(3) Algae

cellulose + mannans + galactan + ~~carotenoids~~
carot3

* Cell wall (cell coat) of plant

- Rigid (hard) and non-living (dead)
- Covering of cell which covers the cell membrane
- In living plant cell, cell wall and protoplast are present. But in dead plant cell only cell wall is present



- pit
Area where secondary cell wall is absent
- Primary wall
thin, flexible, continuous, old, outer
- The primary cell wall is generally thinner and more flexible compared to the secondary wall.

It form a continuous layer that ~~set~~ surrounds the cell.

- The primary wall is older as it first to form during cell development, and it lies on the outer side of cell wall structure.

- Secondary wall:

- The secondary wall is thicker and more rigid than the primary wall, provide additional strength and protection to the cell.

- The secondary cell wall may not be continuous, particularly where pits are located.

- The secondary wall forms later in the cell development and is located inside, b/w the primary wall and plasma membrane

- When cell mature gradually primary wall diminishes due to formation of secondary wall.

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* Chemical composition of plant cell

- In primary cell wall
 - (i) cellulose (main chemical)
 - (ii) Hemi cellulose
 - (iii) pectin
 - (iv) proteins
- In secondary cell wall
 - (i) cellulose
 - (ii) Hemi-cellulose
 - (iii) pectin
- Protoplast secretes some chemical on secondary cell wall.
 - (i) Suberin (fat)
 - (ii) lignin (very hard chemical)
- Middle lamella holds the neighboring plant cell together
- Middle lamella also called plant cement.
It is made of mainly calcium
- During ripening of fruit middle lamella breakdown and fruit ~~bec~~ become soft

* Function of cell wall

- (i) provide shape to plant cell and ~~fug~~ fungus cell.
- (ii) provide cell to cell interaction by the formation of ~~plasma~~ plasmodesmata.
- (iii) protect the cell from damage and mechanical stress.
- (iv) Work as barrier to prevent the entry of undesirable (harmful) macromolecule

* Cell membrane of eukaryotic cell

- RBC is the best cell for study of cell-membrane.
- Biochemical study of RBC revealed that ^{cell membrane of} RBC have 52% protein and 40% lipids.
- later on biochemical study on cell-membrane of RBC revealed that RBC have protein (largest amount), lipid and carbohydrates (least amount)

- Page No. : _____
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- Ration of protein & lipid are variable in cell membrane of different cell of body.

* Chemical composition of cell membrane
→ ~~Three~~ types Two chemical found (mainly)

(1) Lipid (three types)

(a) phospholipid (phosphoglycerids or Lecithin)
• main lipid

(b) Glycolipid

• Carbohydrate + lipid

(c) Cholesterol (stabilier of CM)

• pure lipid

• It make stable to cell membrane

(2) protein

(a) Simple protein

pure protein

(b) glycoprotein

• Two types of protein on the basis of ease of extraction

(a) peripheral (extrinsic/outer) protein
present on the surface of cell membrane
(outside lipid-bilayer)
• less in number

(b) Integral (Intrinsic/inner)
• Buried (embedded) partially or fully inside
• cell membrane (inside lipid bilayer)

~~Carbohydrate~~ • Carbohydrate (sugar)

They never present in free state. They are present in the form of (a) glycolipid and (b) glycoprotein.

• cholesterol is absent in cell membrane of bacteria.

• ~~glyg~~ Glycolipid and glycoprotein are present only at outside of cell-membrane.

Q Why glycolipid and glycoprotein are present out side of cell-membrane

→ Because

(i) Cell to cell recognition
(glycoprotein & glycolipid)

(ii) Binding of virus, hormones, antigens and antibody (only glycoprotein)

* Structure of cell-membrane

Different models were proposed by different scientist. But most improved and most accepted model give by two scientist Singer and Nicolson (1972) ÷ Fluid mosaic

↓ - model

Quasi-fluid

(semi solid = jelly form)

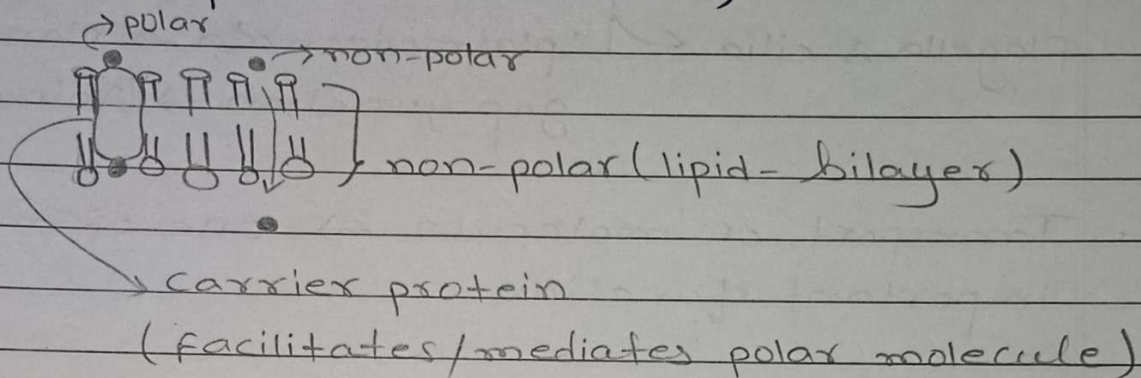
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lipid bilayer

• Scientists measured fluidity (fluid nature) of cell membrane. They saw lateral movement of proteins in lipid-bilayer

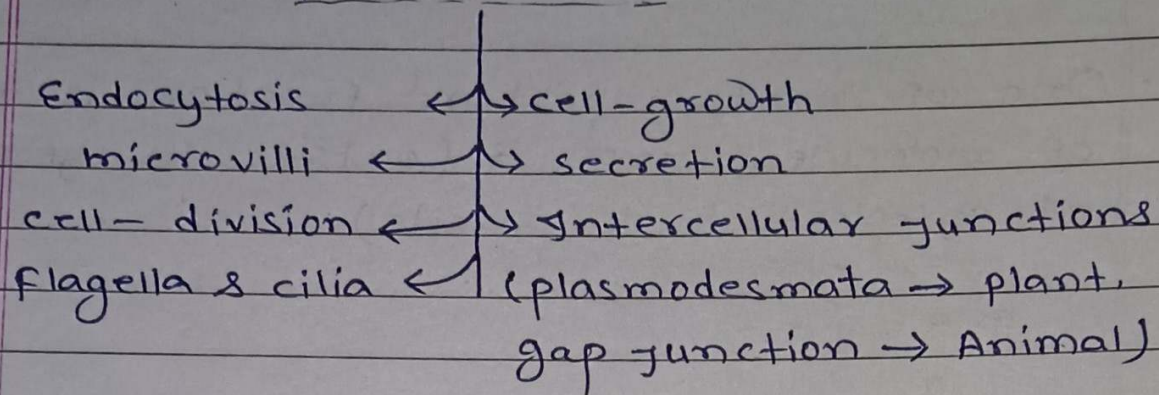
* Function of cell membrane

- One of most important function is transport of molecules across it (outside to cytoplasm side and cytoplasm side to outside)

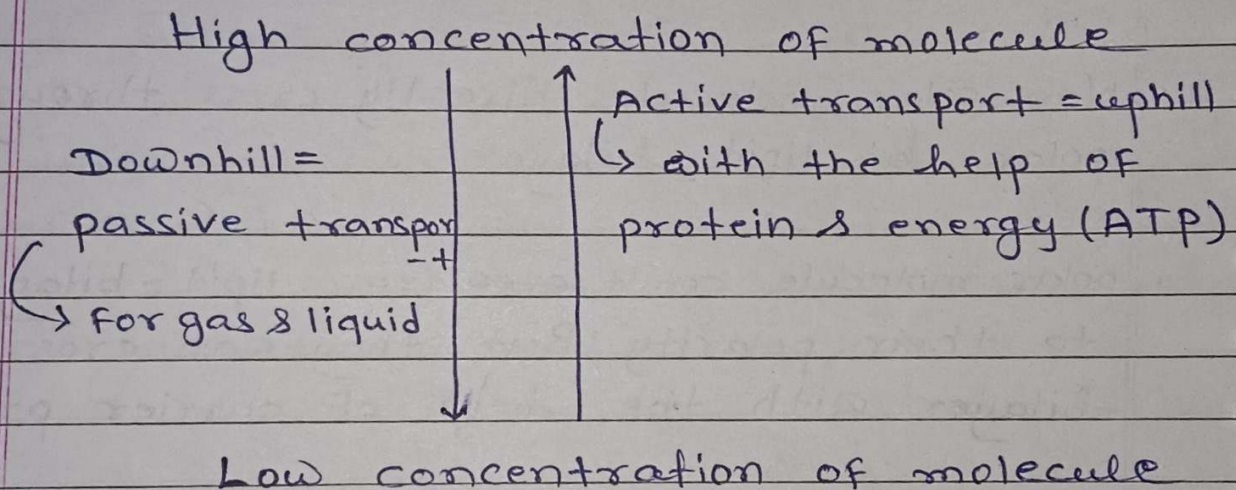


- Non-polar molecules directly cross through non-polar lipid-bilayer
- polar molecule can't cross lipid-bilayer due to their polarity. But they can cross lipid-bilayer with the help of carrier protein
- Work as outer boundary of the cell
- Selective/differentially permeable membrane from either (both) side
- Cell membrane allow the movement of water and selected molecule.

• Due to fluid nature



• Transport of molecule → one of most important function



• Passive transport

molecule moves from high to low concentration without expenditure of energy, along the concentration gradient

- Active transport molecule moves from low to high concentration with expenditure of ATP and carrier protein, ~~ange~~ against concentration gradient
ex: Na^+/K^+ pump

* Endo-membrane system E.R

RER $\rightarrow$ SER $\rightarrow$ golgi-body $\rightarrow$ lysosome $\rightarrow$ vacuole (food)

- Endo-membrane system is a group of structures found in the cytoplasm of - eukaryotic cell

E.R
golgi-body
lysosome
vacuole

} Endo-membrane system

* Endoplasmic Reticulum (E.R)

Tiny (small), tubular (hollow) network/reticulum like structure, scattered in cytoplasm

• There are two compartments/space of E.R

(i) Luminal space/compartment

→ Lumen inside E.R (storage of ^{lipid} protein, ^{enzyme})

(ii) Extra luminal space/compartment

→ It is space on the surface of E.R in cytoplasm.

• 80S ribosomes are present in extra luminal space

* Types of E.R

→ Two types (on the basis of presence and absence of ribosomes)

(1) RER (Rough endoplasmic reticulum)

→ granular E.R

→ 80S ribosomes are present

→ Near the nucleus.

→ most abundant in cell which are actively involved in protein synthesis + secretion

• RER form SER

(2) SER (smooth endoplasmic - reticulum)

→ A granular E.R

→ Ribosomes are absent

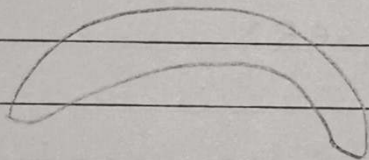
→ Away from nucleus

→ most abundant in the cells which are involved in lipid synthesis + ~~syn~~ synthesis of steroid hormones in animals

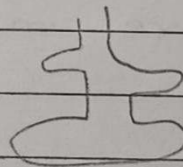
→ SER forms golgi-body

✗ Three structure in (E.R) golgi

(a) Cisternae (RER)



(b) Tubules (SER)



(c) Vesicle (SER & RER)



* Golgi - body

- A densely stained network structure near the nucleus of the cell.
- Discovered by Camillo Golgi in 1898
- Diameter: 0.5 to 1 μm
- Arrangement: Concentric (ring like) pattern around the nucleus
- Interconnected and arranged in parallel stacks
- Convex face (cis face / forming face):
 - Receives vesicles from the smooth - endoplasmic reticulum (SER)
- Concave face (trans face, maturing face)
 - Materials are modified and packed into vesicles
 - Send out vesicles to lysosomes (inside cell) or for secretion (outside cell)

* function of golgi body

- Recive material from SER (at cis face)



Modifications of materials



Movement of modified materials towards trans face



Packing of modified materials in the form of lysosomes/vesicles (at trans face)



Transport of lysosomes inside cell or vesicle outside cell (secretion)

- site of the formation of glycolipid and glycoproteins.
- formation of lysosomes

* Lysosome

- ~~Lysome~~ Lysosome has four types of enzymes

(i) Lipase

→ Digestion of lipid (fat)

(ii) proteases

- Digestion of proteins

(iii) Carbohydrases

- Digestion of carbohydrate

(iv) Nucleases (DNase, RNase)

- Digestion of nucleic-acid

- Lysosomes has almost all types of digestive enzymes (Hydrolases) that work in the presence of H_2O .

- All hydrolases of lysosomes work at acidic-medium (low pH = 5pH). So all enzymes of lysosomes are called acid-hydrolases.

- Function of lysosomes

(i) ~~Intera~~ Intracellular digestion

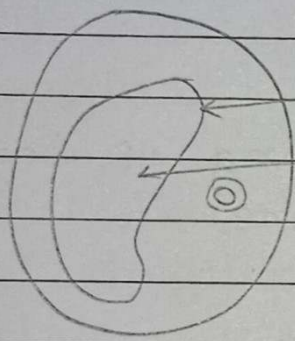
(ii) Extracellular digestion

(iii) Tail-loss in larva of frog (Tadpole)

- The power of WBC to eat bacteria → Due to presence of lysosome

* Vacuole

It is a single membrane bound space in cytoplasm, where water, sap, excretory products and other material are stored that is not useful for cell.



special membrane called Tonoplast
 Empty space in cytoplasm filled
 with water, sap, excretory product
 and other material that is not
 useful for cell

Sap = solution

↳ water + solutes

* Types of vacuole

→ There are three types of vacuole

- (i) Food vacuole
- (ii) Contractile vacuole
- (iii) Sap-vacuole

(1) Food vacuole / Digestive vacuole

→ When lysosome engulf large food vacuole and bacteria it is called food vacuole

→ Food vacuole break down the large food molecule into small and release it in cytoplasm for energy production

→ This type of vacuole found in protista (eg: amoeba and paramecium)

(2) Contractile vacuole

→ for osmoregulation (balancing of water) & excretion (removal of wastes)

→ It is found in protista

(3) Sap- vacuole

→ A single large vacuole, in the centre of plant cell.

→ Occupies (covers) 90% area of plant cell.

Sap = solution (water + Dissolved materials)

→ Organic & inorganic mineral and salts

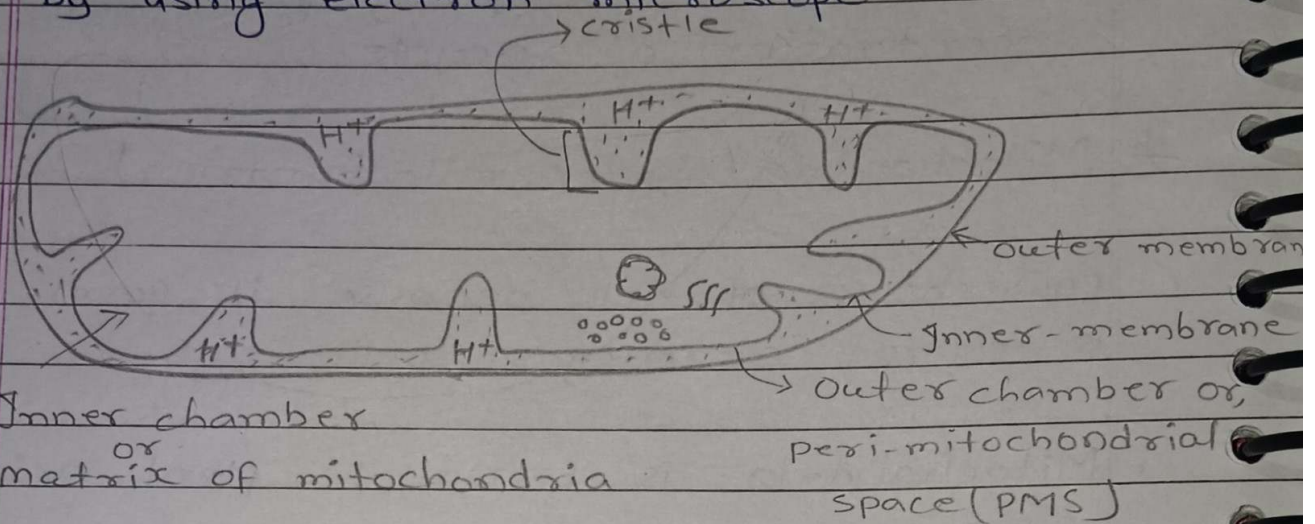
- Tonoplast of sap vacuole has pumps (carrier proteins) which help to move ions from low concentration of cytoplasm to high concentration of vacuole.

* Mitochondria (singular mitochondrion)

- powerhouse of cell because it forms ATP which is energy currency of cell.
- Mitochondria is found in plant, animal and fungi
- size: diameter $\div$ $0.5 \mu\text{m}$
length $\div$ 1 to $4.1 \mu\text{m}$
- Shape $\div$ cylindrical or sausage shape
- ~~A~~ Number of mitochondria differs cell to cell.
- More active cells have high no. of mitochondria
- Less active cells have low no. of mitochondria.
- To see mitochondria under light-microscope a special stain (dye) is used called Janus green

* Ultra structure of mitochondria

We can see ultra structure of mitochondria by using electron microscope.



- Mitochondria has two membrane
 - (i) outer membrane (ii) Inner membrane
- Mitochondria is the place of aerobic respiration
- R • Mitochondria divide by binary fission.
- Mitochondria has bacterial character (70S ribosomes & circular DNA)
- Outer membrane
 - Unfolded, more permeable
- Inner membrane
 - Infolded (infolding called cristae), less permeable

- The space b/w both membrane is called pms.

- There are two ~~aqueatic~~ aqueous chamber or compartment in mitochondria

- (i) Outer chamber

- High concentration of H^+

- (ii) Inner-chamber

- Matrix of mitochondria

- have a single circular ds-DNA + RNAs + 70s ribosomes + protein/enzymes

- Mitochondria have their own protein-synthesis machinery.

- Mitochondria are highly protein/enzymes rich cell organelle.

- * Similarities b/w mitochondria and chloroplast.

- (i) Both divide by binary fission

- (ii) Both have bacterial characters (70s ribosomes + circular DNA + ~~RAN~~ RNAs)

(iii) Both have protein synthesis machinery (70S ribosomes + RNAs)

(iv) Both are semi-autonomous.

* plastids

- A double membrane bound organelle which is found in all plants & euglenoids
- On the basis of pigment there are three types of plastids.

(1) Chloroplast

- green plastids
- Both chlorophylls + carotenoids pigment are present (90% to 95%) (5% to 10%)
- chlorophylls trap/absorb the sunlight for photosynthesis.

(2) Chromoplast

- colourful plastid
- Only carotenoids
- provide colour to seed and fruit

(3) Leucoplast

- no pigment
- colourless plastid
- function: storage

- On the basis of storage leucoplast is of three types

(i) Amyloplast

→ storage of starch (carbohydrate)
eg: potato

(ii) Elaioplast

→ storage of fat/lipid
eg: oil-seed

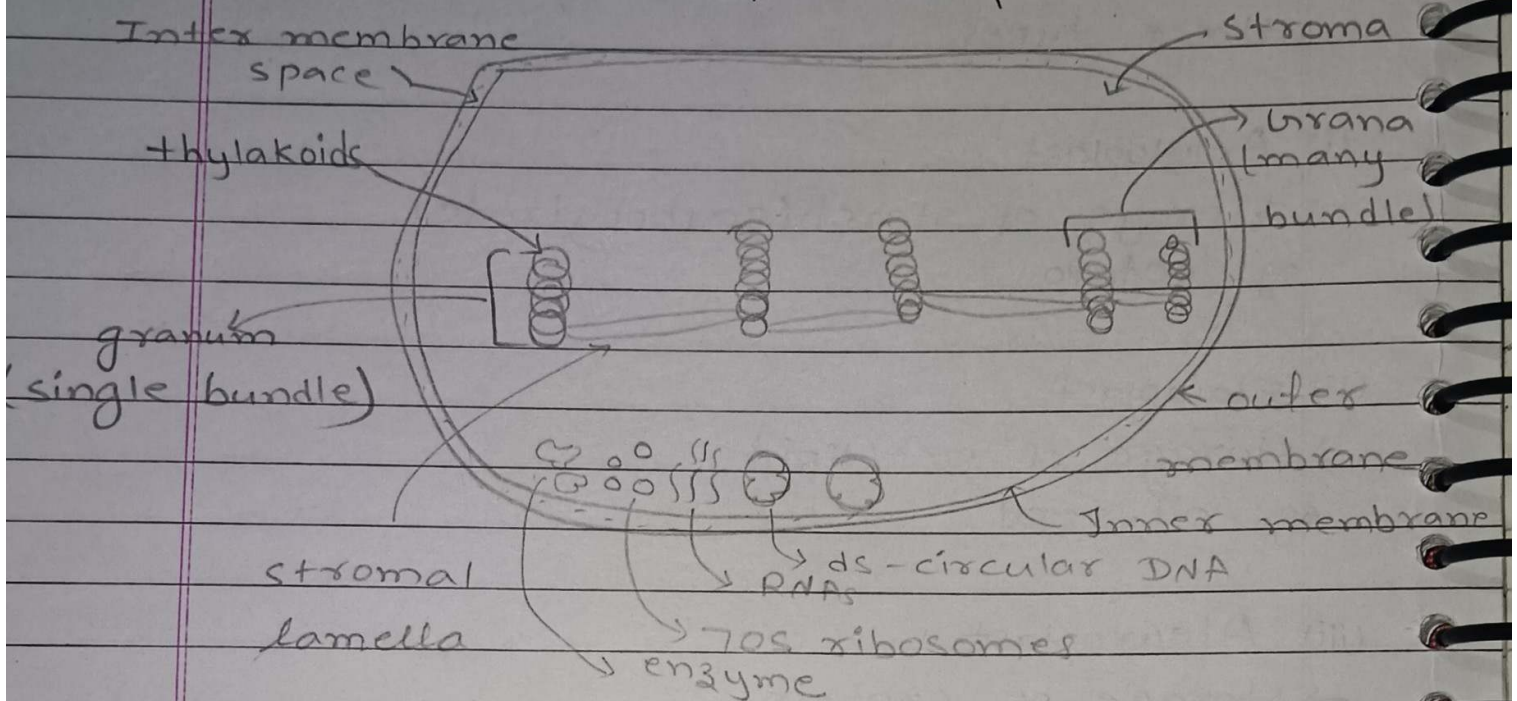
(iii) Aleuroplast

→ storage of protein
eg: pulses

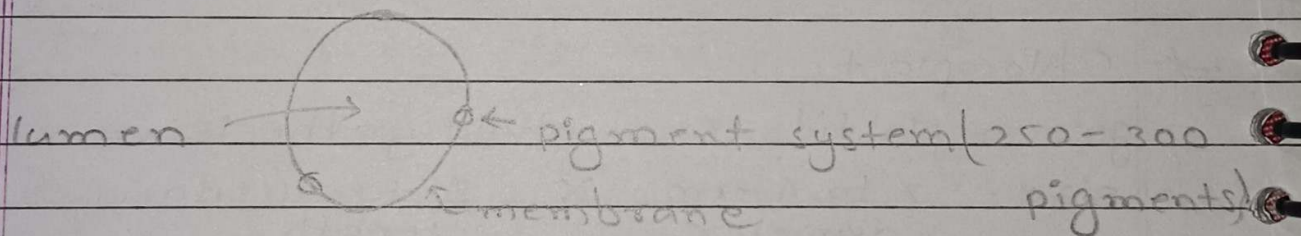
* Chloroplast

- green plastids for photosynthesis
- size $\div$ $\frac{2 \text{ to } 4 \mu\text{m}}{\text{diameter}} \times \frac{5 \text{ to } 10 \mu\text{m}}{\text{length}}$
- Shape $\div$ lens-shape, oval shape, spherical shape, discoid shape, cup-shape, ribbon shape etc.
- Number $\div$ variable cell to cell
- 1 chloroplast $\rightarrow$ In chlamydomonas (cup-shaped chloroplast)
- 20 to 40 chloroplast $\rightarrow$ In mesophyll cell

* Ultrastructure of chloroplast



- A single thylakoid



- Chloroplast is divided into two parts
 - (i) Grana (singular Granum)
 - (ii) Stroma

- Granum is a group of thylakoids which are stacked like piles of coins.

- No enzymes are present in thylakoids (granum)

- pigment (chlorophyll) is present in membrane of thylakoids.
- Granum (thylakoids) is the site (place) of light reaction of photosynthesis (Hill's reaction)
- Stromal lamella connect two or more granum together.
- Stroma is the matrix of chloroplast
- No pigment is present in stroma
- Various enzymes are present in stroma for dark reaction/C₃-cycle/ Calvin-cycle
- 70S ribosomes + many circular DNAs + many RNAs are present in stroma.

*

Tubulin protein (α -tubulin & β -tubulin)

↓ Form

Microtubules

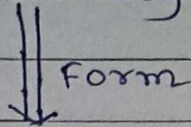
↓ Form

Centrioles (centrosome)

↓ Form

① spindle fibre (ii) Basal body
→ during cell division.

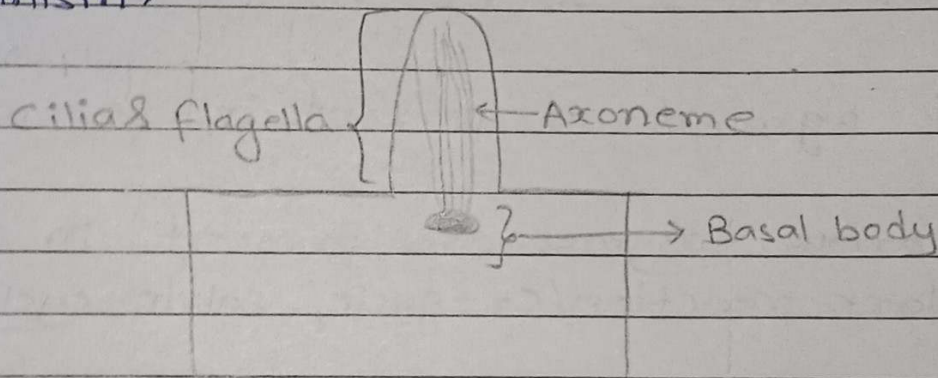
Basal body



Cilia & flagella

* Cilia & flagella

- Hair like structure, outgrowth of plasma membrane.
- It is locomotory organ of unicellular - organism.



- Basal body
 - 9+0 arrangement of microtubules
 - membraneless, in cytoplasm
- Axoneme (cilia & flagella)
 - 9+2 arrangement of microtubules
 - core, single membraned, covered by plasma membrane

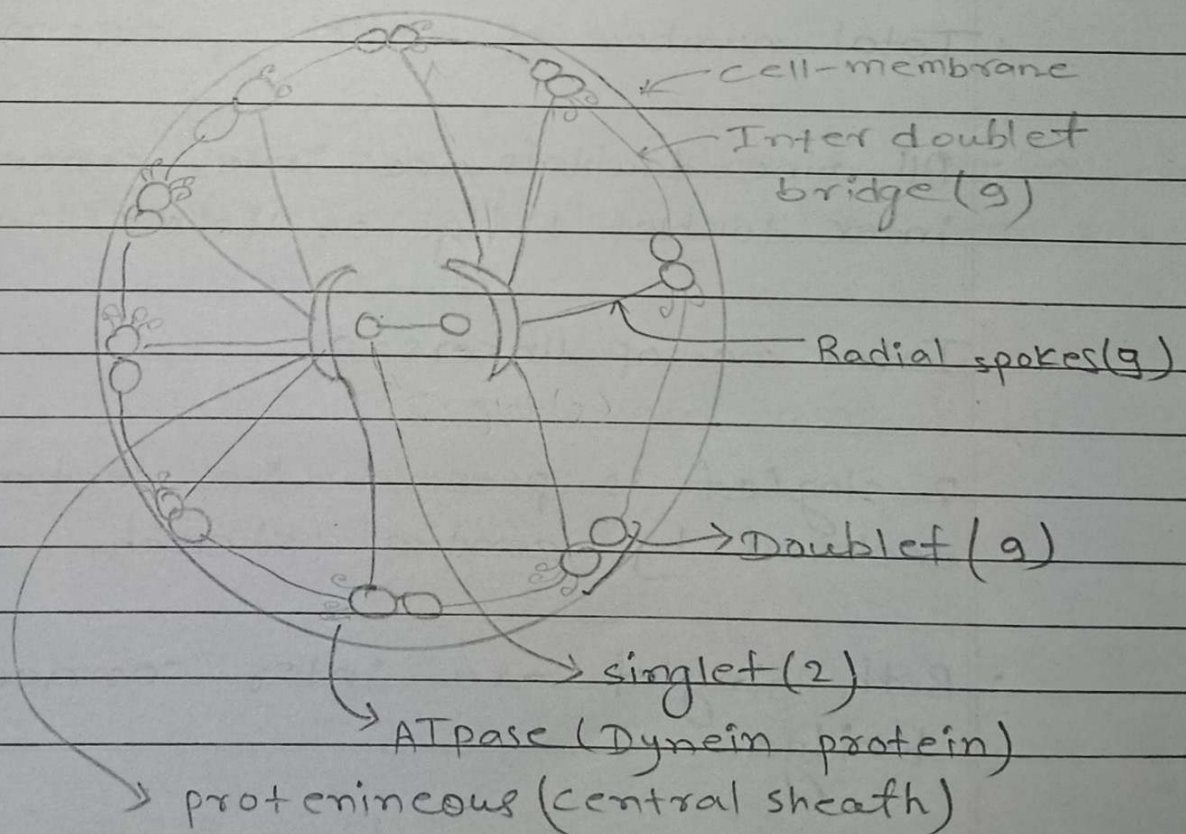
* Cilia (singular cilium)

- found in single cell organism
eg: paramecium (Slipper-animal)
- Shorter, many (hundreds)
- Help in locomotion of organism
- Also help in movement of body-fluids and gases
- Work as oars (fast stroke & slow recovery)

* Flagella (singular flagellum)

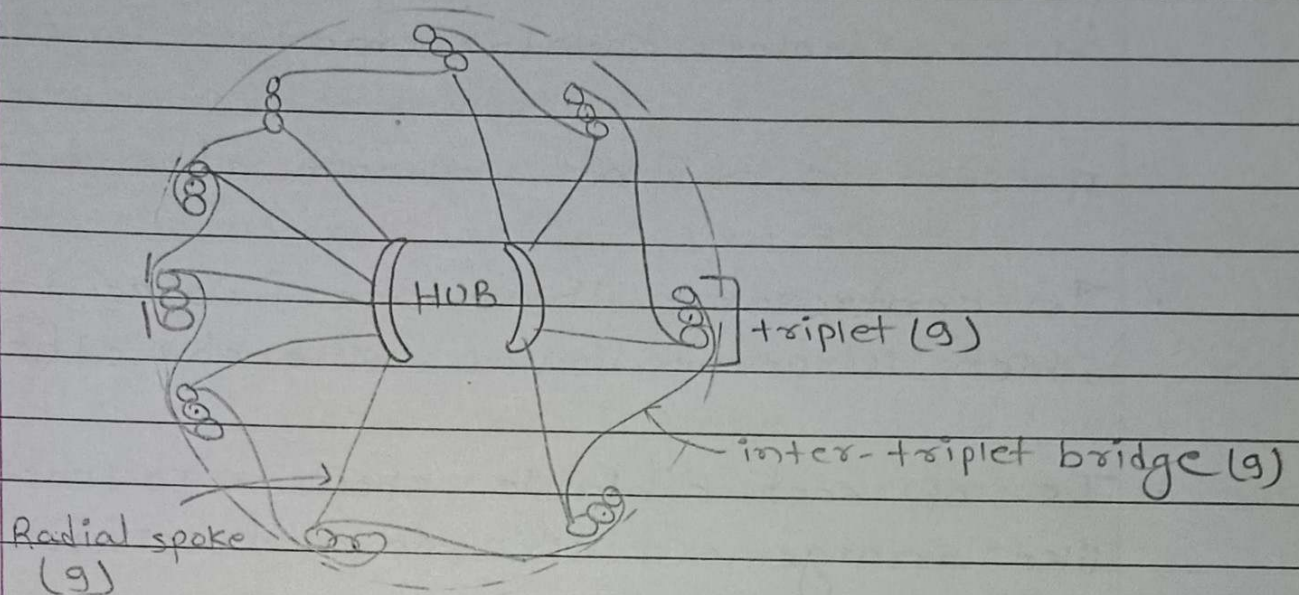
- found in single cell organism
- ~~larger~~ longer, few (1 to 8)
- eg: Chlamydomonas
- Helps in locomotion of organism
- Work like wave (Undulating)

* T.s of cilia and flagella



- ~~Cilia~~ Cilia or flagella have $9+2$ arrangement of axoneme.
here 9 means 9 doublets (periphery/radial) and 2 mean 2 singlets (central) microtubules.
- Total number of microtubules = 20
- There are two portion of cilia or flagella
(i) Cell membrane (ii) Axoneme
- In axoneme
 - 9 peripheral doublets are present. Each peripheral doublet connected with central sheath by radial spokes
 - Total number of radial spokes = 9
 - All nine doublets are inter connected by inter doublet bridge or linker
 - Total no. of linkers = 9
 - 2 singlet is present in centre which is enclosed by central sheath.
 - Both singlet are inter connected by bridge.

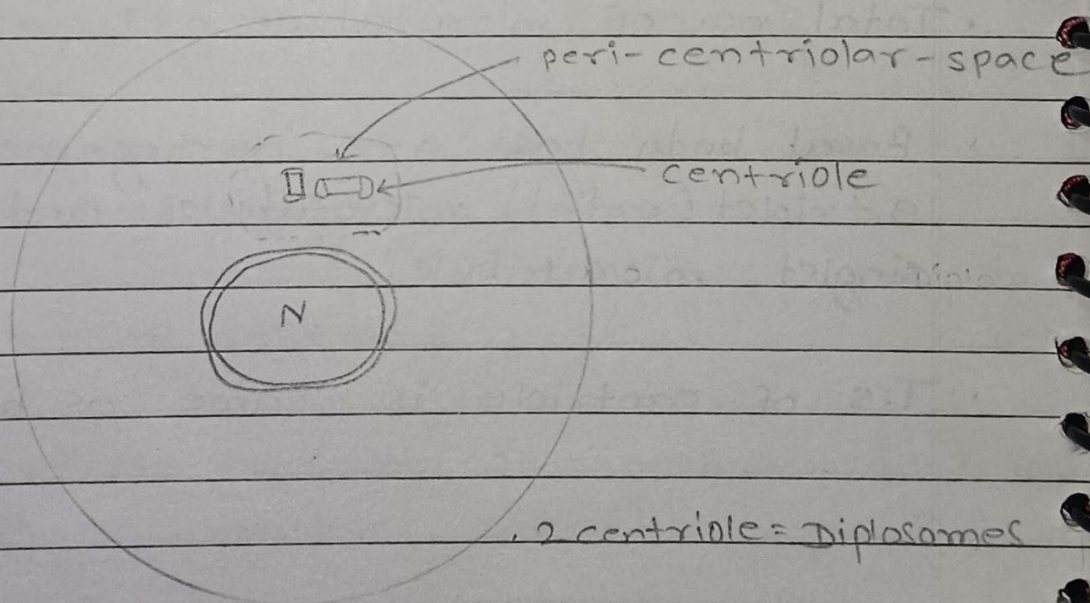
* T.S of basal body



- Basal body is not covered by cell membrane.
- Basal body is cart wheel like structure.
- Total no. of microtubules = 27
- Basal body has $9+0$ arrangement. here 9 mean 9 triplet (radial) microtubules and 0 mean zero singlet microtubule.
- T.S of centriole is same as basal body.

* Centrosome

- peri-centriolar space (amorphous substance) + centrioles = Centrosome
- present in animals, almost absent in plant
- In centrosome there are two centrioles which are perpendicular to each other.
- T.S of each centriole shows 9+0 (cartwheel) like arrangement of microtubules which is same as basal body.
- Centrosome is membraneless and present just above the nucleus.



Animal cell

* Ribosome

- Membraneless and smallest cell - organelle
- Soluble cell organelle
- Engine of cell because ribosomes synthesise proteins/enzymes which is necessary for working of cell.
- Ribosome are called palade's particle because it is discovered by George palade (1953)
- Ribosomes also called Ribonucleoproteins because it is made of rRNA and proteins
- Ribosomes are granular structure.
- Ribosomes are only cell organelle which is found in both prokaryotes and eukaryotes.

* Types of ribosome

There are two types of ribosomes.

(1) 70s ribosome (smaller ribosome)

- found in prokaryotic cell and inside two cell organelles of eukaryotes (chloroplast and mitochondria)
- 70s ribosomes are cell organelles within cell organelle (inside mitochondria & chloroplast)

- Important points

- (i) S = sedimentation - coefficient or Svedberg's unit. It is indirectly depend on size and density (mass)
- (ii) Each ribosome is made of two subunit; larger subunit and smaller subunit.
- (iii) When larger and smaller subunit are free $\Rightarrow$ Inactive state of ribosome
- (iv) When larger and smaller subunit are joined (over mRNA) $\Rightarrow$ Active state of ribosome
In this state, ribosomes are ready for synthesis of protein/enzyme.
- (v) High concentration of Mg^{++} is required to associate smaller and larger subunit over mRNA

2 Subunit of ribosomes

- 70S $\left\{ \begin{array}{l} 50S \text{ (larger subunit)} \\ 30S \text{ (smaller subunit)} \end{array} \right.$

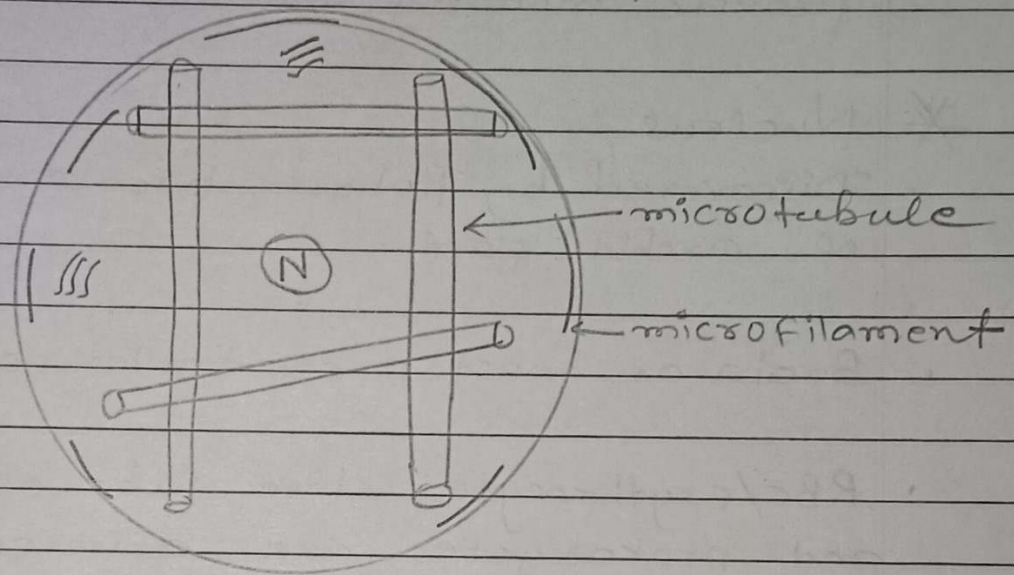
$$60S + 40S = 80S$$

$$30S + 50S = 70S$$

- 80S $\left\{ \begin{array}{l} 60S \text{ (larger subunit)} \\ 40S \text{ (smaller subunit)} \end{array} \right.$

* Cytoskeleton

- Bone of cell
- It includes microfilaments, microtubules and intermediate filaments.



• Microfilament

- Solid, contractile, small
- Made of actin protein (contractile protein)
- Diameter: $8\text{ }\mu\text{m}$

• Microtubule

- Hollow, non-contractile
- made of tubulin-protein (non-contractile protein)
- Diameter: $\approx 25\text{ }\mu\text{m}$

• Intermediate filament

- Hollow, non contractile
- Made of different-types of protein
- Diameter: $11\text{ }\mu\text{m}$

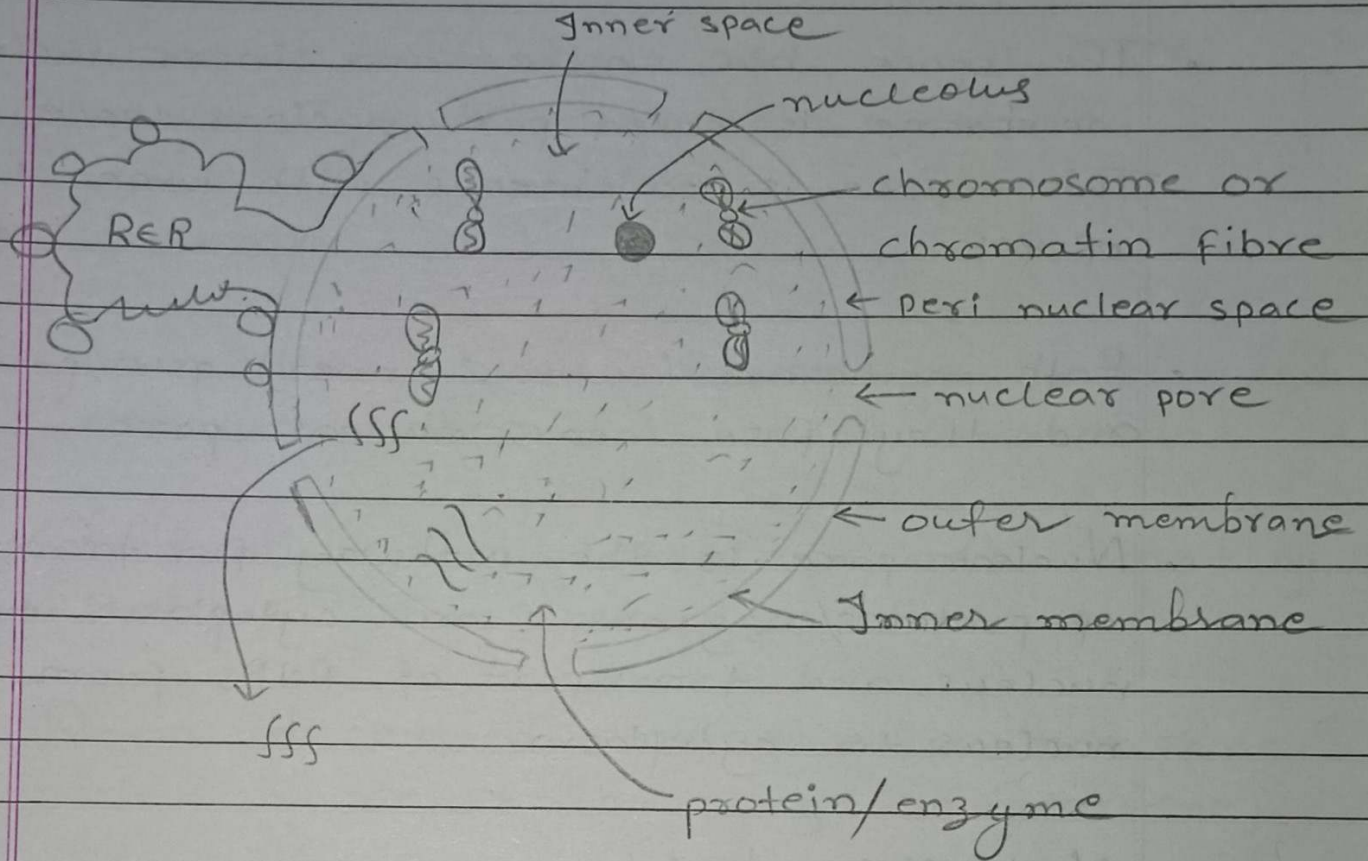
* Function of cytoskeleton

- (1) Maintains the shape of cell
- (2) Support the cell
- (3) provide mobility (movement) to the cell.

* Nucleus

- Discovered by Robert Brown in root cell of Orchid - plant.
- Brain or master controller of cell
- RBC/erythrocyte, sieve tube of phloem and prokaryotes are anucleated cells (cells without nucleus)
- Generally one nucleus is present in a single cell (uninucleated cell). But sometimes many nuclei are present in a cell (multinucleated cell or syncytium or coenocytic)
- In some organism two nuclei is present in one cell (binucleated cell)
eg: paramicium

* Ultra structure of Nucleus



- Outer membrane + peri-nuclear space (thickness 10nm to 50nm) + Inner-membrane = Nuclear envelope or karyotheca.
- proteins/enzymes always synthesis inside cytoplasm
- There are two membrane of nucleus
 - (1) Outer nuclear membrane
 - It is continuous with RER, both outer nuclear membrane and RER has 80s ribosomes.

(2) Inner ~~me~~ nuclear membrane

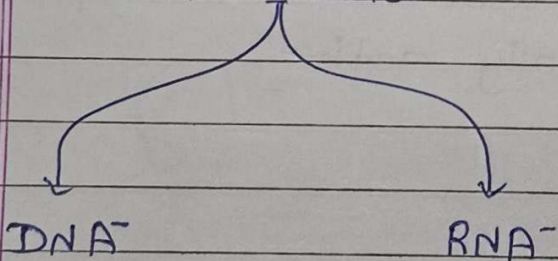
- The space b/w outer and inner nuclear membrane is called peri-nuclear space.
This space is continuous with ~~lumen~~ lumen of RER.
- Both membrane (outer & inner) run parallel and they fuse near nuclear-pore.
- Nuclear pore is the pathway for transport of proteins/enzymes from cytoplasm to nucleus and transport of RNAs from ~~nucleus~~ nucleus to cytoplasm.
- Nucleoplasm has ÷
 - (i) Chromatin/chromosomes
 - (ii) RNAs
 - (iii) proteins & enzymes
 - (iv) Nucleolus (ribosomes - factory)
- Nucleolus (plural nucleoli)
 - The content of nucleolus continuous with nucleoplasm
 - It is a small structure
 - Number of nucleolus varies cell to cell

- Generally one nucleolus is found in nucleus of a single cell. But sometimes many nucleoli are present in nucleus of a cell. Which is actively involved in protein synthesis.

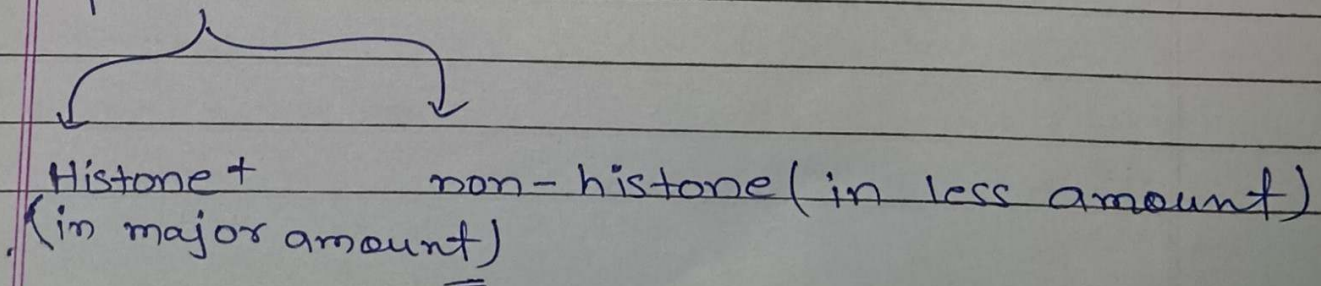
* Chromatin

- When DNA is less coiled and more extended (elaborated) then it is called chromatin.
- Chromatin is discovered by and named by Fleming.
- Fleming discovered chromatin in interphase nucleus by use of basic dye (acetocarmine).
- Chromatin also called nucleoprotein fibre because it is made of nucleic acid and protein.

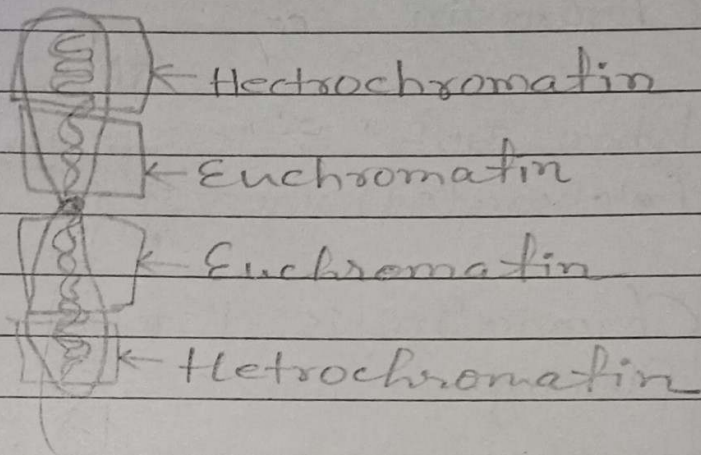
Nucleic acids



protein



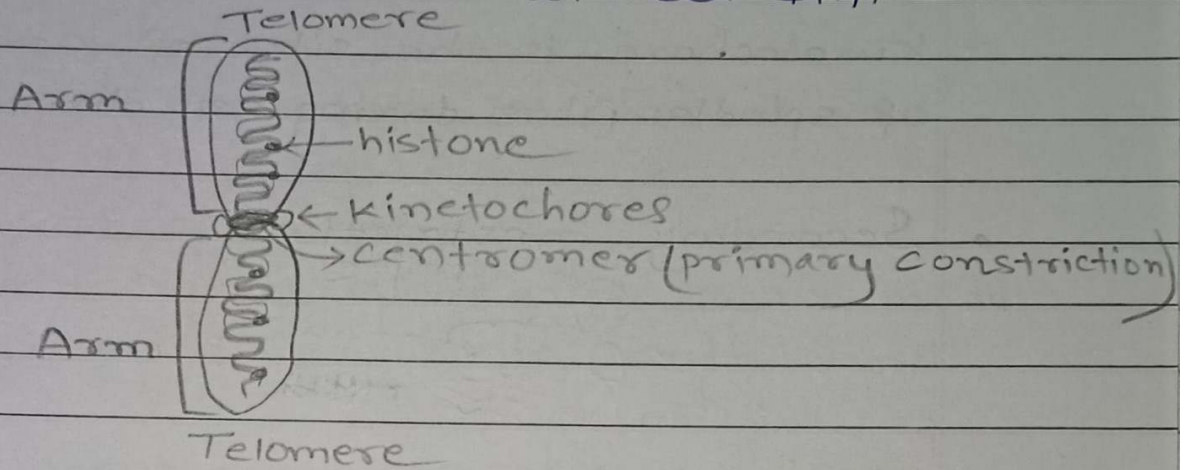
- Histone attach with DNA and do coiling of DNA.
- Chromatin = DNA + RNA + Histone + Non-Histone



- Heterochromatin
 - highly coiled DNA, high concentration of histone
 - genes transcriptionally inactive
- Euchromatin
 - Less coiled DNA, low concentration of histone
 - genes transcriptionally active.

* Chromosome

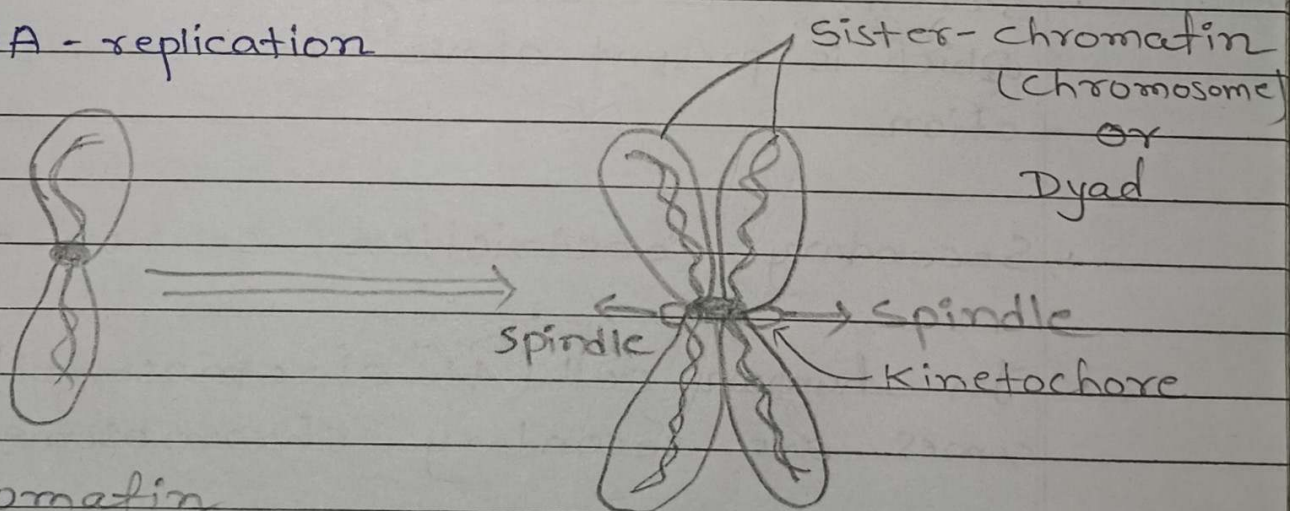
- Highly coiled and less extended DNA



- Chromosome has :-

- one DNA molecule (highly coiled)
- Two telomere
- Two arms
- one centromere
- Two kinetochores
- In some chromosomes secondary constriction is present

- DNA - replication



chromatin

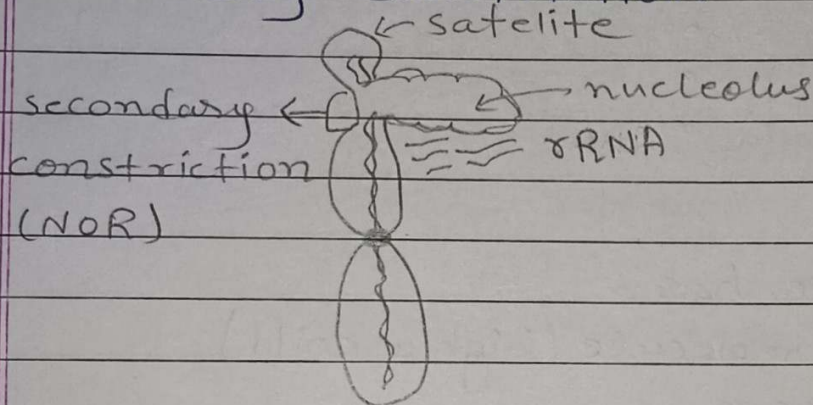
(when cell is not dividing)

Chromosome

(when cell is dividing)

- Kinetochore is proteinaceous disc like structure
- Kinetochore is the site of attachment of spindle fibre during cell division

- Secondary constriction



SAT/secondary chromosome

- Secondary chromosome is that chromosome which has secondary constriction.
- Satellite is small segment of chromosome which is present above the secondary constriction.
- Secondary constriction is non-staining
- In human cell (46 chromosomes) 10 chromosomes are secondary-chromosome

* Types of chromosome (on the basis of location of centromere)

- There are four types of chromosome

(1) Metacentric chromosome

- The centromere is located in the middle, making both arm equal in length.

(2) Submetacentric chromosome

- The centromere is slightly off-center, making one arm longer than the other.

(3) Acrocentric chromosome

- The centromere is located near ^{one} end, resulting in a very short arm and a long arm.

(4) Telocentric chromosome

- The centromere is at extreme end, so chromosome has only one arm.
- Shorter arm $\rightarrow$ (p)
- longer arm $\rightarrow$ (q)

* Microbodies

- Minute (small) vesicle like structure
- Single membrane bound
- Various types of enzymes are present
- Formed by E.R (SER)

* Types of microbodies

There are three types of microbodies

(1) Peroxisomes

→ Found in both animal and plant

(2) Glyoxysomes

→ Found only in plants

(3) Sphaerosomes

→ Found only in plants

→ Also known as ~~ribosome~~ lysosome of plant

Cell cycle and cell division

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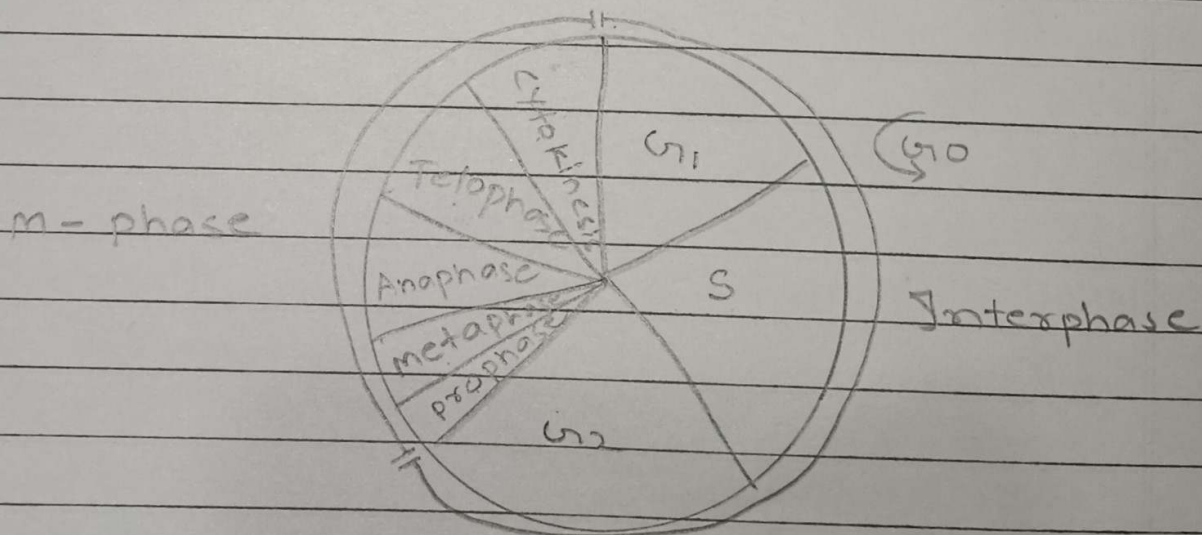
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* Introduction

- Human body cell takes about 24 hours in cell cycle and yeast cell take about 90 minute
- In the 24 hours average duration of cell cycle of a human cell, cell division proper lasts for only about an hour. The interphase last more than 95% duration of cell cycle.
- Somatic cell
 - Any cell of multicellular organism except reproductive cell (sperm and ova) ^{is} are called somatic cell.

* Mitosis

Mitosis is a type of cell division in which a diploid ($2N$) or haploid (N) parent cell divide into two daughter cells. These daughter cell are genetically similar to each other and to the parent cell.



- Interphase includes G_1 , S and G_2 phase
- There is an phase called G_0 phase. When a cell doesn't want to divide it exist from G_1 phase and enter in G_0 phase.
- The G_0 phase cell may enter in cell cycle (ex: muscle cell) or peramanently exist the cell cycle (ex: neuron)
- Mitosis also called equational division because the number of chromosome in parent cell and progeny cells is same.

The Living World

Page No. : _____
Date : _____

* Features (characters) of living organism

- (i) Cell
 - (ii) Metabolism
 - (iii) Consciousness
 - (iv) Growth
 - (v) Reproduction
- } Defining - feature
- } Non-defind defining feature

* Metabolism

All chemical reactions occur in body/cell of organism.

There are two types of metabolism

(i) Anabolism

Constructive chemical reaction

eg: photosynthesis (formation of glucose)

(ii) Catabolism

Destruction chemical reaction

eg: Respiration (breakdown of glucose)

* Consciousness

Awareness for environment

In all living organism

* Self-consciousness

- Awareness about self
- Only in human

* Growth

- Increase in number and mass (weight, volume)
- Growth is observed both in living and non-living.
- Living growth (irreversible growth) by formation of new cells inside body (internal or intrinsic growth)
- Intrinsic growth ÷ defining feature of living organism.
- Non-living growth (reversible growth) by deposition of materials on the surface (External/extrinsic growth)
ex ÷ growth of boulders, growth of sand dunes.

* Reproduction

- Giving the birth of young ones (offsprings) similar to itself

exception ÷ Intertile (sterile) couple

* Taxonomy

Rules of arrangement (classification) of organism

- IUCN in 2004 say that about 1.7 to 1.8 million species has discovered and described.

* Steps of taxonomy

- There are four steps of taxonomy

Step I. Characterisation
listing of characters

Step II. Identification
Identify the organism on the basis of characters

Step III. Classification
placing of organism in appropriate categories

Step IV. Nomenclature
Giving binomial name

* phylogeny

Evolutionary relationship among organisms
eg: Fishes → Amphibians → Reptiles → mammal
(primitive) (advanced)

Taxonomy + phylogeny = Systematics

Taxonomy in consider with phylogeny is called systematics.

* Systematics

- Derived from ~~the~~ Latin word 'Systema'
- Meaning systema is systematic arrangement of organism.
- Carolus Linnaeus used systema word as title of his book "Systema Naturae"

* Binomial - Nomenclature

- Nomenclature of organism in two words is known as binomial nomenclature.

- Binomial nomenclature given by Carolus Linnaeus (father of modern taxonomy)
- The principles & criteria for binomial nomenclature are made by ~~not~~ international organisations ICBN, ICZN and ICNB
 ↳ oldest organisation
- ICBN → International Code of Botanical Nomenclature. (for plant & fungi)
- ICZN → International Code of Zoological Nomenclature
- ICNB → International Code for Nomenclature of Bacteria

* Name of organism

Local name

or

Vernacular-name

Scientific-name

or

Biological-name

Vary country to country and also vary in different state within a country. It is standardised name which is same all over the world.

name given by
local people.

These name is given in
'Latin' (Latin is now
dead language, not in use)

* Binomial nomenclature

Name of organism given in two words in
Latin.

1st word → Generic - epithet (name of genus)

2nd word → Species - epithet (name of species)

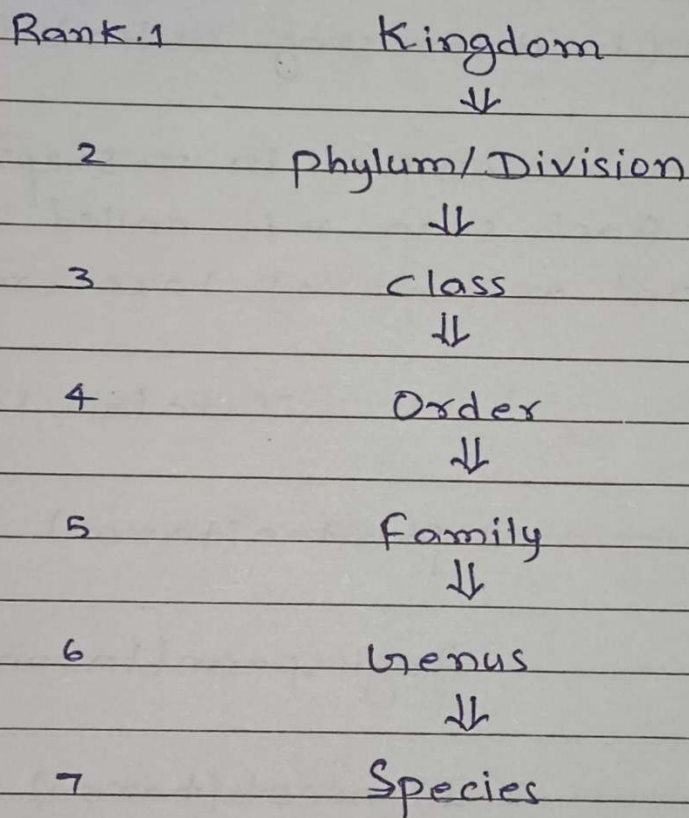
* Rules of binomial nomenclature

- (1) Both epithets (words) must in Latin or Latinised.
- (2) First letter of genus is capital
- (3) All letter of species are small
- (4) Name of genus & name of species are underlined (when handwritten) separately or written in Italics (when printed). To show Latin-origin.

(5) Use of abbreviation (short form) of the person who 1st discover the organism at the end of species (without punctuation, underlined & *Italics*)

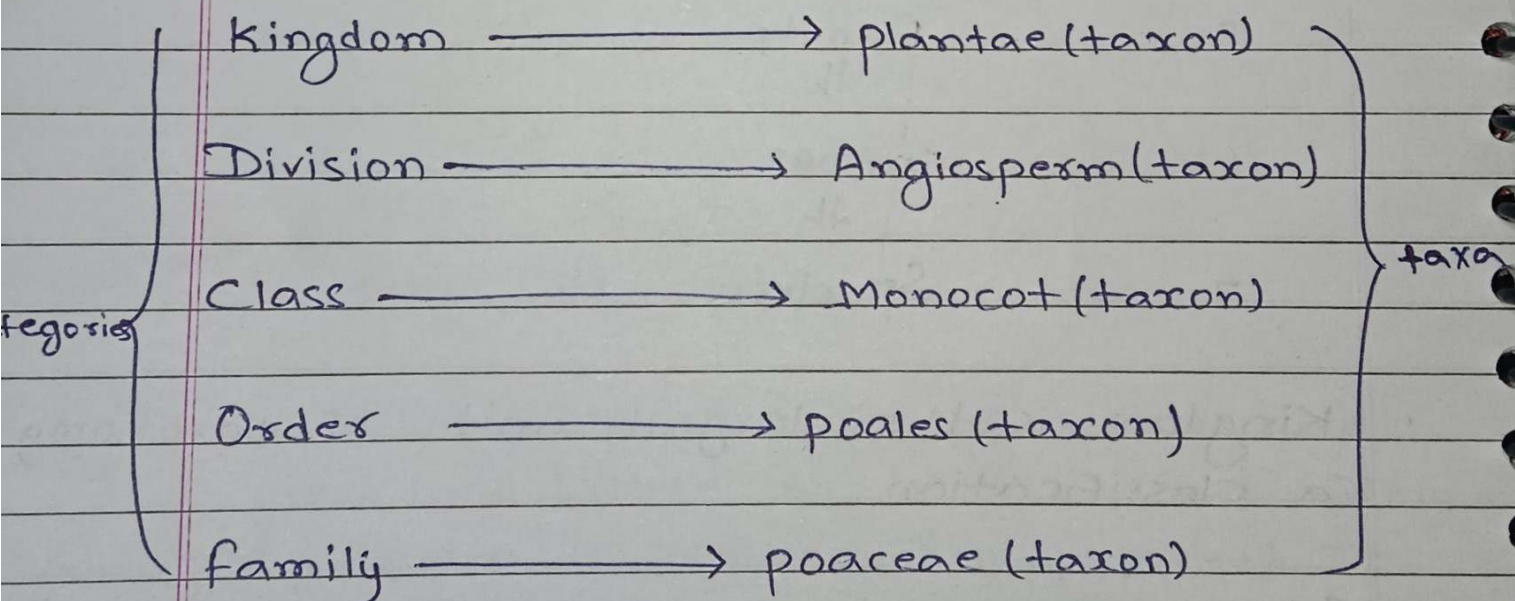
eg: Mangifera indica, *Homo sapiens* (*Italics*)

↳ Taxonomic categories



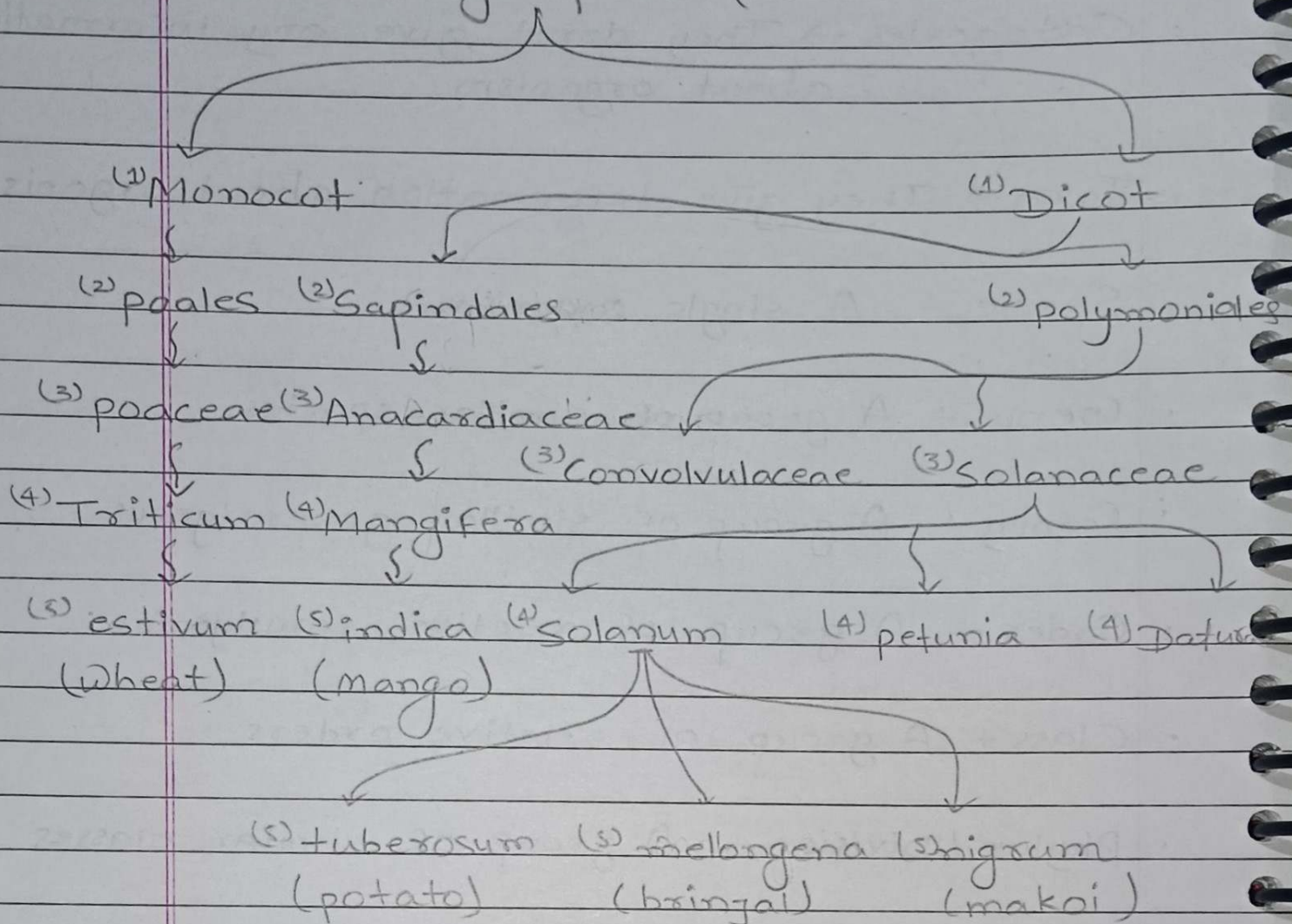
- Kingdom is the largest unit of taxonomy or classification.
- Species is the smallest unit of taxonomy or classification.

- Kingdom to species $\rightarrow$ Common character and no. of organism decrease
- Species to Kingdom $\rightarrow$ Common character and no. of organism increases
- Kingdom, phylum/Division, class, order, family, genus, species $\rightarrow$ 7-obligate taxonomic categories or, 7-taxonomic-ranks (steps) in hierarchies (in decreasing order)
- All organism are classified in 7-steps or 7-categories. Each step # is called "unit of classification" or "unit of taxonomy"
- Categories Taxa (sin. taxon)



- Categories → They don't give any information about organism.
- Taxa → They give information about organism.
- Species ÷ A single organism.
- Genus ÷ A group of similar species
- Family ÷ A group of similar genera/genus
- Order ÷ A group of relative families
- Class ÷ A group of relative orders
- Phylum/Division ÷ A group of similar classes
- Kingdom ÷ All phyla/Divisions

* Angiosperm (Division)



(1) → class, (2) → order, (3) → family
(4) → genus, (5) → species.

- Monotypic genus → The genus which has only one species.
- Polytypic genus → The genus which has many species.

Animalia (Kingdom)

① Arthropoda

↓

② Insecta

↓

③ Diptera

↓

④ Muscidae

↓

⑤ Musca

↓

⑥ domestica

(House fly)

① Chordata

↓

② Mammalia

③ Carnivora

③ primata

↓

④ Homonidae

↓

⑤ Homo

↓

⑥ sapiens

(Human)

⑥ domestica (cat)

④ Canidae

↓

⑤ Canis

⑥ familiaris

(Dog)

④ Felidae

⑤ panthera

⑤ felis

⑥ sapiens

(Human)

⑥ domestica (cat)

⑥ leo

(lion)

⑥ tigris

(tiger)

⑥ pardus

(leopard)

1 → phylum, 2 → class, 3 → Order, 4 → Family
5 → genus, 6 → species.

Biological Classification

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* Aristotle

- 1st person who classified plant and animal on the basis of morphology (scientific character)
- He classified plant into three groups
(i) Tree (Tall) (ii) Shrubs (medium) (iii) Herbs (small)
- He classified animal into two groups
(i) Enima → Animal with RBC
(ii) Anima → Animal without RBC

* Linnaeus

Linnaeus classified all organism into two - kingdom
(i) plantae (ii) Animalia

* Ernst Haeckel

3 kingdom classification
(i) plantae (ii) Animalia (iii) protista

* Copeland

4 - Kingdom classification
(i) plantae (ii) Animalia (iii) protista (iv) Monera

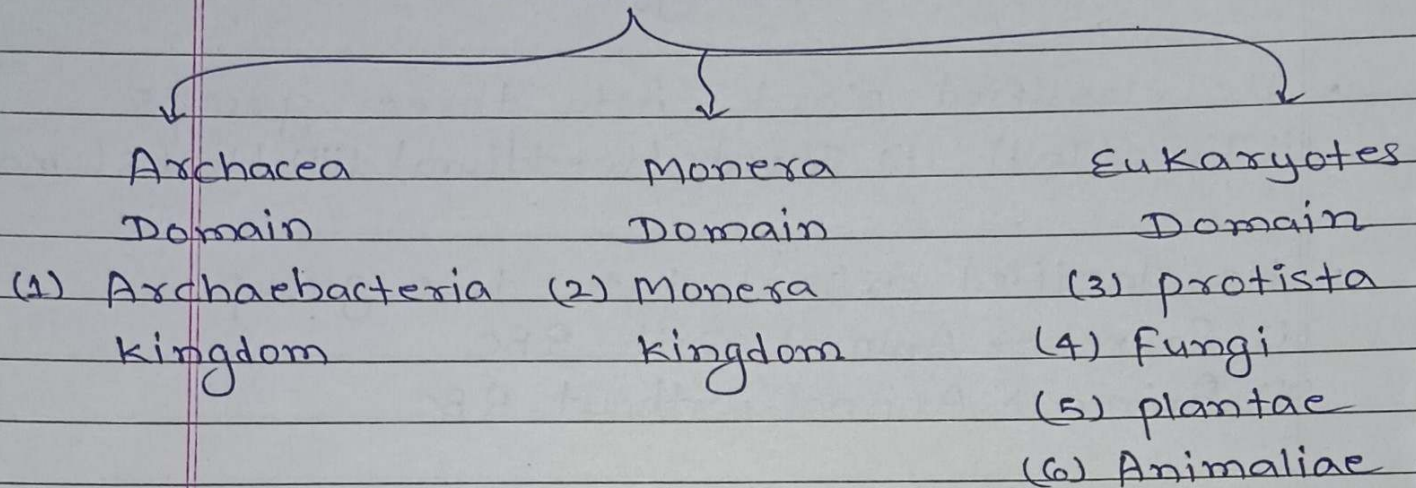
* R.H. Whittaker (1969)

5 kingdom classification
(i) Monera (ii) protista (iii) fungi (iv) plantae
(v) Animalia

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* 6-kingdom (3-domains) classification

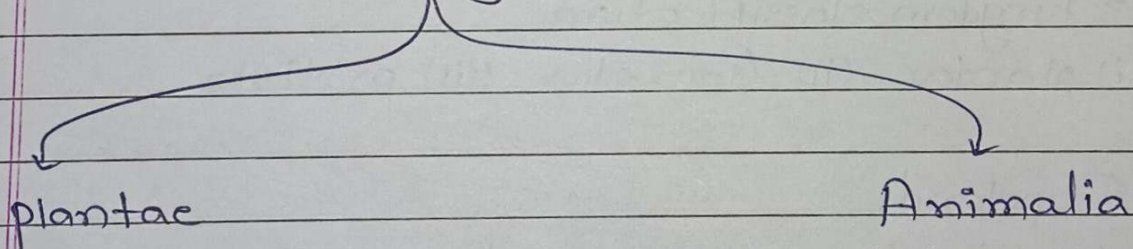
3-domains



* 2 Kingdom classification

- Given by Linnaeus
- on the basis of presence/absence of cell wall

2 Kingdom



• Cell wall is present
All plant, fungi & bacteria

• Cell wall is absent
• All animal
protozoa (unicellular) +
metazoa (multicellular)

- Cell wall of fungi is made of chitin
- Cell wall of cellulose is made of cellulose
- Cell wall of bacteria is made peptidoglycan

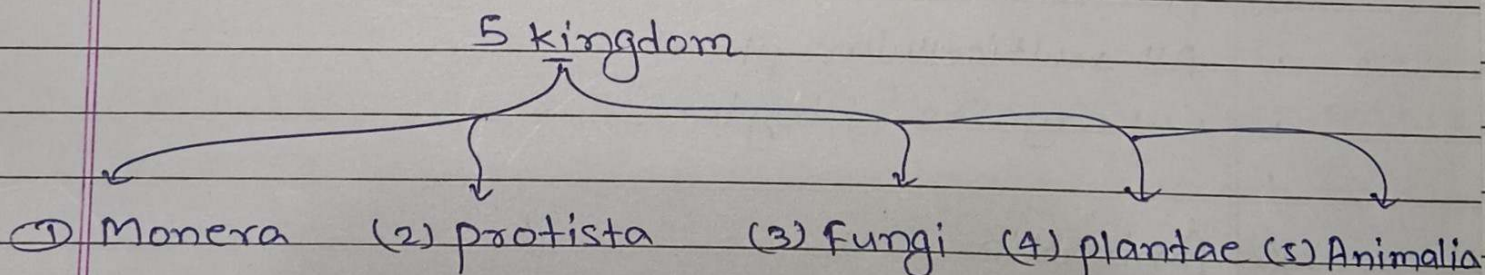
note: Virus, Lichen, viroids and prions have no place in any kingdom.

* Demerit of two kingdom classification (Linnaeus)

- (i) He could not differentiate unicellular and multicellular
- (ii) He could not differentiate photosynthetic & non-photosynthetic
- (iii) He could not differentiate chemical composition of cell wall
- (iv) He could not differentiate prokaryotes and eukaryotes

* 5-kingdom classification (R.H. Whittaker, 1969)

- On the basis of (i) mode of nutrition (ii) Type of cell (iii) cellular organisation (iv) mode of reproduction (v) phylogenetic relationship



(1) Monera (primitive Kingdom)

It

- Unicellular, prokaryotic Kingdom
- All bacteria (Eubacteria + Archaeobacteria)
- Eubacteria → All bacteria around us
- Archaeobacteria → present in extreme conditions.

(2) Protista

- unicellular, eukaryotes Kingdom
- includes unicellular plant, animal and fungi
- ex:- protozoa (unicellular animal)
- Slime moulds (unicellular fungi)
- 3 unicellular algae (dinoflagellate, chrysophytes & Euglenoids)

(3) Fungi

- All multicellular fungi
- eukaryotes Kingdom

* plantae

- All multicellular plant
- eukaryotes Kingdom

* Animalia

- All multicellular animal
- eukaryotes Kingdom =

Q. How many kingdom has autotrophic or photosynthetic organism

→ plantae (all plant) + Monera (some bacteria) + protista (some protista)

Q. Which kingdom doesn't have limited boundary?

→ protista

reason: If we found any unicellular ~~eukaryotic~~ eukaryotic organism, we can put in protista kingdom except *Chlamydomonas* & *Chlorella* (unicellular ^{algae} ~~algae~~)
Amoeba and *Paramecium* (unicellular animal)

* Kingdom Monera

- Bacteria are sole member of Kingdom Monera. They are most abundant micro-organism.

- Hundreds of bacteria are present in a handful soil.

- Bacteria also lived in extreme habitats such as hot springs, ~~desert~~ desert and deep oceans where very few other life forms can survive.

- Many bacteria live in or on other organisms as parasites.

- Bacteria are divided into four groups on the basis of shape.

(i) Coccus shape (ii) Bacillus shape (iii) Vibrio-shape (iv) Spirillum shape.

- The structure of bacteria is very simple but they are complex in structure.
- Some bacteria are autotrophic, they synthesise their own food from inorganic substrates: They may be photosynthetic autotrophic or chemosynthetic autotrophic.
- The vast majority of bacteria are heterotrophic. They depend on other organisms or dead organic matter of food.
- There are two phylum of Monera Kingdom
(i) Archaeobacteria (ii) Eubacteria

* Archaeobacteria

- Archaeobacteria are special since they live in some of most harsh habitats.
- Archaeobacteria differ from other bacteria in having a different cell-wall structure and this feature is responsible for their survival in extreme conditions.

- On the basis of habitats archaeobacteria are classified into 3 groups.

(1) Halophiles bacteria

→ The bacteria which are found in salty areas.

(2) Thermoacidophiles bacteria

→ The bacteria which are found in hot springs.

(3) Methanogens bacteria

→ The bacteria which are found in marshy areas.

→ Methanogens are present in gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (bio gas) from the dung of these animals.

* Eubacteria (true bacteria)

- Eubacteria characterised by the presence of rigid cell wall.

- Some eubacteria are motile (flagellated).

- Cyanobacteria (blue green algae) are eubacteria.

- Cyanobacteria

→ unicellular, colonial or filamentous, fresh water / marine or terrestrial bacteria.

- Filamentous are generally surrounded by gelatinous (mucilaginous) sheath.
- Cyanobacteria have chlorophyll a similar to green plants and are photosynthetic autotrophic.
- Some of cyanobacteria has heterocysts which can fix atmospheric nitrogen.
ex: Nostoc & Anabaena.
- Chemosynthetic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They play a great role in recycling nutrients like nitrogen, phosphorous, iron, and sulphur.
- Heterotrophic bacteria are most abundant. The majority are important decomposers. Many of them have a significant impact on human affairs. They are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume root etc.. Some are pathogens causing damage to human beings, crops, farm animals and pets. Cholera, typhoid, tetanus, citrus, canker are well known diseases caused by different bacteria.

- Bacteria reproduce mainly by binary fission. But under unfavourable conditions, they produce spores. They also reproduce by a sort of sexual reproduction by adopting a primitive type of DNA transfer from one bacterium to the other.
- The mycoplasma are organisms that completely lack a cell wall. They are smallest living cells known and can survive without oxygen. Many mycoplasmas are pathogens for human and plants.

* Kingdom protista

- All unicellular eukaryotes (plant, fungi and animals) are placed in protista kingdom. But the boundaries of this kingdom are not well-defined.
- Member of protista are primarily aquatic.

Being eukaryotes, the protistan cell body contains a well-defined nucleus and other membrane-bound organelles.

Some protista have cilia or flagella.

- Protista reproduce by asexually and sexually by a process involving cell fusion and zygote formation.
- Protista are divided into five groups (i) Chryophytes (ii) Dinoflagellates (iii) Euglenoids (iv) Slime moulds (v) protozoans.

* Chrysophytes

- This includes diatoms and golden algae (desmids). They are found in fresh as well as marine environments. They are microscopic and float passively in water current (plankton). Most of them are photosynthetic.
- Diatoms
 - In diatoms the cell wall form two thin overlapping shells, which fit together as in a soapbox.
 - The cell wall are embedded with silica and thus the wall are indestructible. Thus diatoms have left behind large amount of cell wall deposits in their habitat, this accumulation over billions of year is referred as "diatomaceous earth".

→ When diatoms die the wall of it where silica is absent break and make a hole through which soil enter in dead diatoms. The gritty soil is used in polishing (metal), filtration of oils and - syrups.

→ Diatoms are the chief producers in the oceans.

* Dinoflagellates

- These organism are mostly marine and photo synthetic.
- They appear yellow, red, green, brown and blue depending on the main pigment present in their cells.
- The cell wall has stiff cellulose plate on the outer surface.
- Most of organisms has two flagella. One lies longitudinally and the other transversely in a furrow b/w wall plates.

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- Red dinoflagellates (ex: Gonyaulax) undergo such rapid multiplication that they make the sea appear red (red tides). Toxins released by such large number may even kill the other marine animals such as fishes.

* Euglenoids

- Majority of euglenoids are fresh water organisms found in stagnant water.
- Euglenoids lack cell wall instead of that, they have a protein rich layer called pellicle, which makes their body flexible.
- They have two flagell a short and a long one.
- They are photosynthetic in the presence of sunlight. When deprived sunlight they behave like heterotrophic by predateding on other small organism.
- pigments of euglenoids are similar to those present in higher plants (ex: Euglena)

* Slime moulds

- Slime moulds are saprophytic protista, which mean they obtain their nutrients by decomposing dead and decaying organic matter.

- The body moves along decaying twigs and leave engulfing organic material

- Under suitable conditions, they form an aggregation cells called plasmodium which may grow and spread over several feet.

During unfavourable condition the plasmodium differentiates and form fruit body bearing spores at their tips.

- The spores possess a true wall which is extreme resistant and survive for many years, even under adverse conditions. The spores are dispersed by air currents.

* protozoans

- All protozoans are heterotrophic and live as predators or parasites (ex: Entamoeba)

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- They are primitive relatives of animals
 - There are four groups of protozoans

(1) Amoeboid protozoans

- These organism live in fresh water, sea-water or moist soil
- They move and capture their prey by putting out pseudopodia (false feet) as in Amoeba
- Marine forms have silica shells on their surface.

(2) Flagellated protozoans

- The member of this group are either free-living or parasitic.
- They have two flagella
- parasitic form cause diseases such as sleeping sickness (ex: Trypanosoma)

(3) Ciliated protozoans

- These are aquatic, actively moving organisms because of the presence of thousand of cilia. They have a cavity (gullet) that opens to the outside of cell surface. The coordinated movement of rows of cilia causes the water laden with food to be ~~stre~~ steered into gullet.
ex - paramecium.

(4) Sporozoans:

- These includes diverse organisms that have an infectious spore-like stage in their life cycle. The most notorious is plasmodium (malaria - parasite) which cause malaria, a disease which has a staggering effect on human pollution x population.

* Introduction

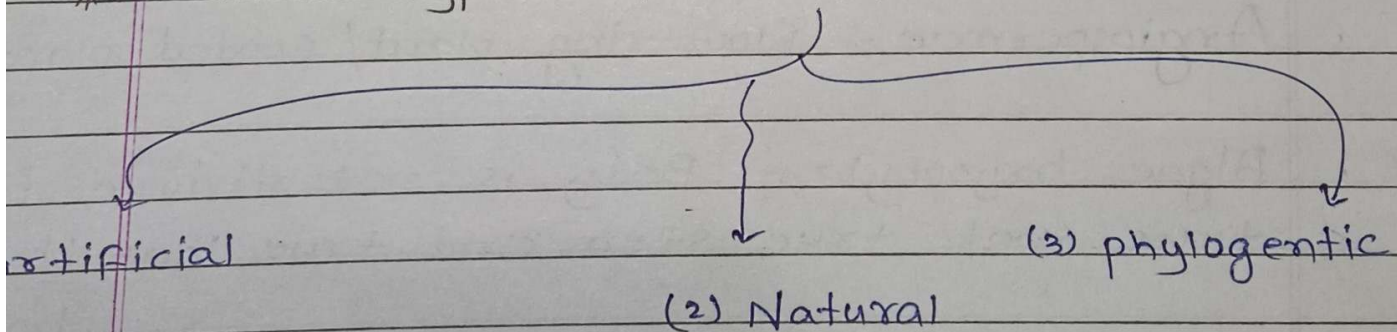
plant is divided into 5 divisions

- (1) Algae (Thallophyta) ÷ primitive plant
- (2) Bryophyta
- (3) Pteridophyta
- (4) ~~gymno~~ Gymnospermae
- (5) Angiospermae ÷ Advance plant

- phyta/phytes = plants
- Spermae = seed
- Gymnospermae and angiospermae are seeded plant (spermatophytes or phanerogams)
- Algae, Bryophyta and pteridophyta are seedless plant (aspermaphytes or cryptogames)
- Aquatic plant ÷ Algae (fish of plant)
- Terrestrial plant ÷ Bryophyta, pteridophyta, gymnospermae and angiospermae
- Angiospermae ÷ flowering plant/ fooded plant
- Algae, bryophyta ÷ Body is not divided into true root, true stem and true leaf (thallus-body).

- Pteridophyta, gymnospermae and angiosperm
↳ true root, true stem and true leaf
- Pteridophyta, gymnospermae and angiospermae
have vascular bundle (Xylem and phloem)
and tracheophyte (xylem cell)
- For seed formation spore must be unequal
(micro spore $\div$ male, mega spore $\div$ female). Its
mean male spores and female spores are unequal
in (Heterospores) in gymnospermae and
angiospermae.
- Algae $\div$ meiosis, non jacketed (not covered)
sex organ
- Bryophyta, Pteridophyta, ~~gymnosper~~ gymnosperm
and angiospermae $\div$ mitosis, jacketed (covered)
sex organ =

* Three types of classification



(1) Artificial classification

- Basis of classification ÷ morphology (external - characters)
- Given by carolus Linnaeus
- Demerit ÷ Equal weightage of vegetative part (root, stem, leaf) and sexual part (flower, fruit, seed)

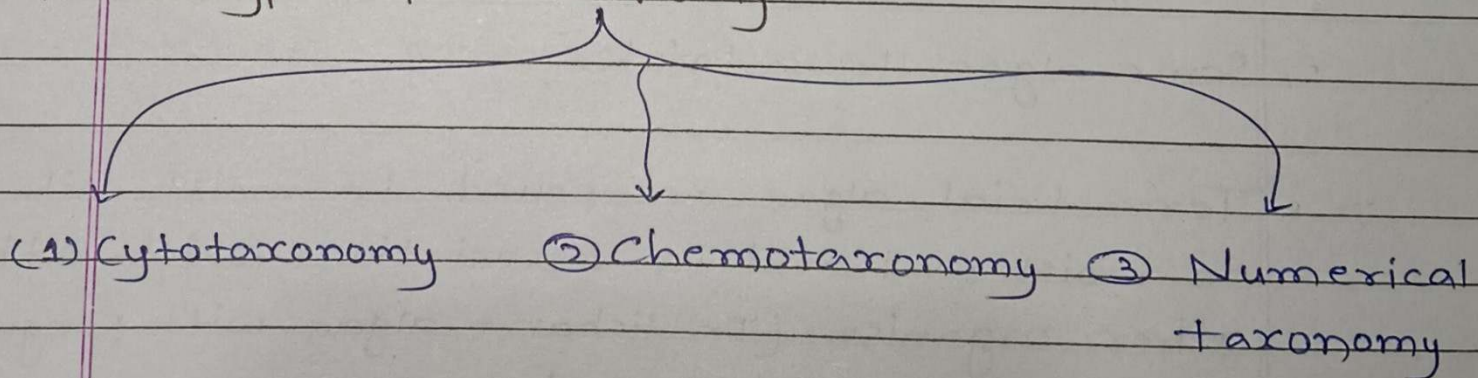
(2) Natural classification

- Basis of classification ÷ morphology + anatomy + embryology + cytology + phytochemistry
- Given by George Bentham and Dalton Joseph Hooker.

(3) phylogentic classification

- Basis of classification ÷ Natural classification + phylogeny

* 3-types of taxonomy



- Cytotaxonomy
 - Taxonomy on the basis of cytology (cytological characters). It includes number, structure and behaviour of chromosomes.
 - Chemotaxonomy
 - Taxonomy on the basis of phytochemistry
 - Numerical taxonomy
 - Hundreds of characters are considered using computers. All characters have equal weightage
- * Algae
- Aquatic (water-living) plant
 - phyco = algae
 - phycology / Algology = study of algae
 - phycologist / Algologist = scientist of algae
 - Algae are found in all water (freshwater, marine water and brackish water)
 - Some algae terrestrial
 - Terrestrial algae are found in moist soil, on moist wall and in association with other organism (In lichen = algae with fungus, on body of sloth bear)

* Body of algae

(1) Colonial algae (spherical)

→ Volvox algae (spermotile)

(2) Filamentous algae

→ Ulothrix



(3) Tree-like algae

→ Laminaria, fucus, Dictyota, porphyra, polysiphonia

* Types of algae

(1) Chlorophyceae (Green algae, GA)

includes ÷ Volvox and Ulothrix

(2) Phaeophyceae (Brown algae, BA)

includes ÷ Laminaria, fucus, Dictyota

(3) Rhodophyceae (Red algae, RA)

includes ÷ porphyra, polysiphonia

* Reproduction in algae

(1) Vegetative reproduction

÷ By fragmentation of body of algae

(2) Asexual reproduction

· By formation of asexual spore

- Under favourable condition
formation of zoospores (most common spore, motile)
- Under unfavourable condition (high tem.)
 - (a) Aplanospores (thin wall, non-motile)
 - (b) Hyphospores (thick wall, non-motile)

(3) Sexual reproduction

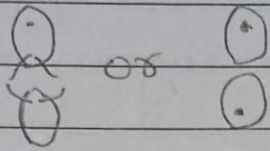
- External fertilisation/in-vitro fertilisation
- fertilisation in water medium, male gamete and female gamete are released in water

* 3-Types of sexual reproduction in algae

(1) Isogamous (2) Anisogamous (3) Oogamous

(1) Isogamous

- Similar male and female gamete in size and motility.



eg: Chlamydomonas (motile)

Spirogyra (non-motile)

(2) Anisogamous

- Disimilar male gamete (small) and female gamete (large) in size.
- Both have flagella. eg: Eudorina

(3) Oogamous

- In all organism
- male gamete small and motile
- female gamete large and non-motile
- eg: Fucus, Volvox

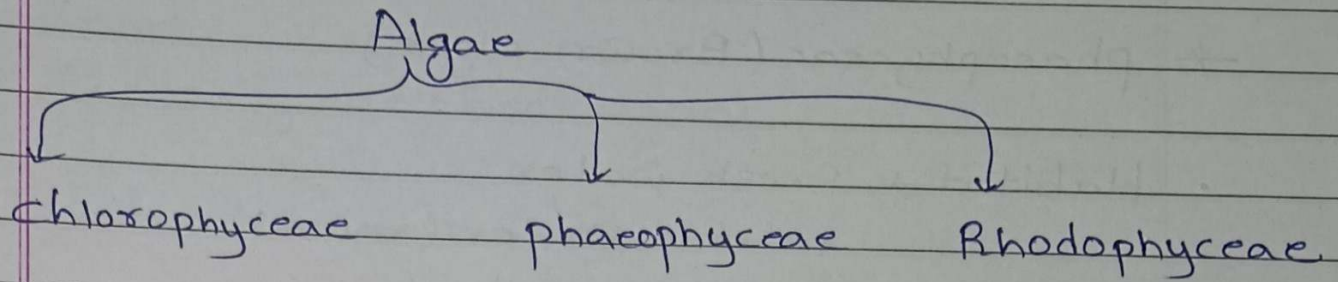
* Important of algae

- Half (50%) of earth's CO_2 fixed by algae
- 50% of O_2 of the earth released by algae
- About 70 marine species of algae are used as food.
- ex: Laminaria, Sargossum, Porphyra etc.

- Some carbohydrate ÷ (i) Algin (Alginate / Alginic acid)
(ii) Agar-Agar
(iii) Carrageen
- Algin, agar-agar and carrageen are Hydrocolloid (solidifying agents) means all have highest water absorbing capacity.
- Algin carbohydrate found in brown algae.
- Agar-agar and carrageen found in red algae.
- Source of agar-agar ÷ (i) Gelidium red algae
(ii) Gracilaria red algae
- Hydrocolloids commercial used for making jams, jellies, icecreams, chocolates, cosmetics, toothpaste, powders, ointments.

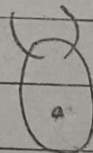
* Classes of algae

R.H whittaker divided all algae in three classes on the basis of types of pigment, chemical composition of cell-wall, types of reserve food material and number, size and position of flagella.



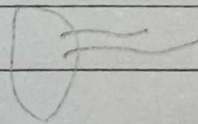
* Chlorophyceae (Green algae)

- Habitat ÷ Fresh water (most)
Marine water
Brackish water
- Pigments
Chloro-a, chloro-b
- Stored foods
Starch (simple carbohydrate)
↳ Amylose + Amylopectin
- Cell-wall
cellulose (inner layer) + pectose (outer-layer)
- Flagella
number ÷ 2 to 8
size ÷ equal
position ÷ Apical



* phaeophyceae (Brown algae)

- Habitat ÷ fresh water
marine water (most)
Brakish water
- Pigments
chloro-a, chloro-c, fucoranthin (brown pigment)
- Stored foods
Laminarin, Mannitol (complex alcoholic carbohydrate)
- Cell-wall
cellulose (inner-layer) + Algin (outer gelatinous-layer)
- Flagella
number ÷ 2
size ÷ unequal
position ÷ lateral



~~* Rhod~~

* Rhodophyceae (Red algae)

- Habitat ÷ fresh water
Marine water (most)
Brackish water
- Pigments
chloro-a, chloro-d, phycoerythrin (red-pigment)
- ~~Star~~ store foods
Floridean starch (complex starch)
↳ only Amylopectin
- Cell-wall
cellulose (inner layer) + Agar-agar or Carrageen
or polysulphate ester spectin
- Flagella
No flagella

Morphology of flowering plant

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* Introduction

- Study of external structures of angiosperms (flowering plant) is known as morphology of flowering plant.
- Vegetative part of plant
Root, stem, leaf
- Reproductive part of plant
flower, fruit and seed
- Flowering plant has two system
 - (i) Root system
 - below the soil
 - includes root
 - (ii) Shoot system
 - above the soil
 - stem and leaf
- +ve phototropic = toward the sun
-ve " = Away from the sun
- +ve geotropic = toward gravity, earth/soil
-ve " = Away from gravity

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- Roots are -ve phototropic and +ve geotropic. except $\div$ pneumatophores (eg: Rhizophora)
 - Stems are +ve phototropic and -ve geotropic.
 - pneumatophores grow above the soil to take O_2 & release CO_2 . It is +ve phototropic and -ve geotropic.

* Root

Underground part of a vascular plant

* Types of Root

- (1) Tap root
- (2) Adventitious Root
- (3) Fibrous root

* Tap root

Direct elongation of the radicle leads to the formation of primary root which grows inside the soil. It bears lateral roots of several orders that are referred to as secondary, tertiary etc. Roots. The primary roots and its branches constitute the tap root.

ex: Dicots (eg: mustard plant)

* Fibrous root

In fibrous root, tap root is short lived and is replaced by a large numbers of roots. These roots originate from base of the stem.

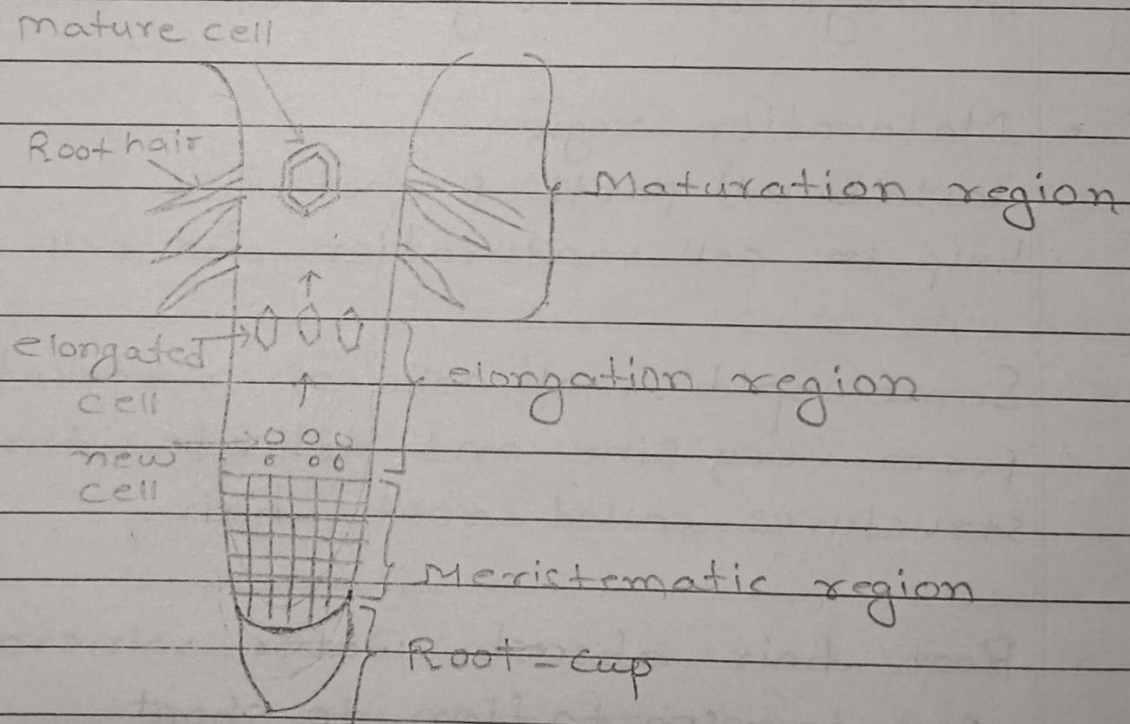
eg: Monocots (eg: wheat)

* Adventitious root

Adventitious root arise from other parts of plant other than the radicle.

eg: grass, monstera, banyan tree.

* Regions (parts/zones) of root



- Root cup

The root is covered at the apex by a thimble like structure called root cup. It protect the tender apex of root.

- Meristematic region

Few millimeters above the root cup is the region of meristematic. The cell of this region are very small, thin walled and with dense protoplasm. meristematic region continues do mitosis to produce many new cells.

- Elongation region

proximal and above the meristematic region. Elongation region help in elongation of root in length and elongation of new cells.

- Maturation region

- last (basal) part of root
- help in cell maturation and cell-differentiation.

Some epidermal cells of maturation region form very fine and delicate, thread like structures called root hair.

- Root hair absorb water minerals from soil for transportation to shoot.

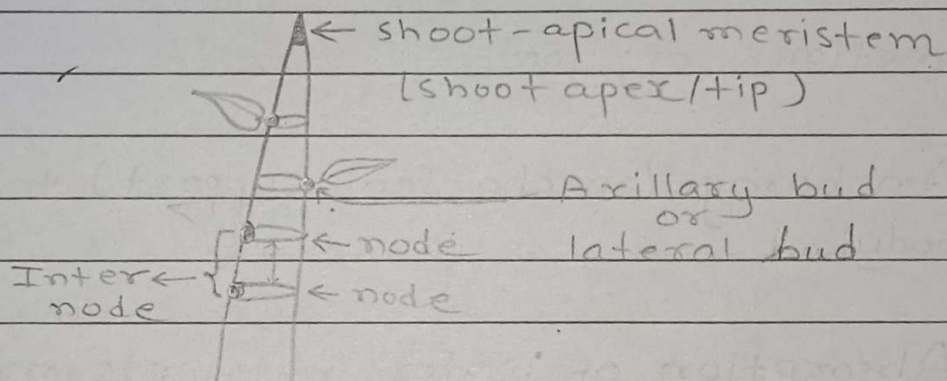
- Root cap is absent in secondary and tertiary tap root and free floating aquatic plant.
- In free floating aquatic plant in the place of root cap, root pocket is present. Root pockets are filled with air to provide buoyancy (floating)

* Functions of root

- (1) Anchorage (mechanical support) to the plant body
- (2) Absorption of water, nutrients and transported to shoot.
- (3) Storage of food (transported to shoot in autumn)
- (4) In root apex, synthesis of plant hormone/phyto hormone/plant growth regulators (PGRs)

* Stem

- Ascending (upward) part
- +ve phototropic and -ve geotropic
- Young stem $\longrightarrow$ Green & weak (from germinating seed)
- Older stem $\longrightarrow$ Dark brown & woody (hard)



- node $\div$ The region of stem where leaves are born are called node
- Internode $\div$ The distance b/w two nodes
- node has axillary bud or lateral bud
- Apex of stem has terminal bud or shoot apex

- position of flower/fruit in most of plants are lateral side.
- Stem divided into nodes and internodes
- Node bear leaf/branch/axillary bud/flower/fruit/adventitious root, they are spread at lateral side of stem.

* function of terminal bud

(1) formation of leaf

(2) formation of axillary bud (left behind cell of-terminal buds)

(3) Increase the length of stem/axis

(4) In some plant (ex: china rose) terminal bud form flower.

* function of axillary buds

(1) formation of new flower

(2) formation of new branches

- (3) In some plant (wood-apple, citrus, Bougainvillea) axillary bud form thorns for protection from herbivores (cow/cattle)
- (4) In some plant (cucumber, grapes, Watermelon, pumpkin, gourds) axillary buds form tendrils (coil-like) for support the climbers.
- (5) Axillary bud can develop into a new plant

* function of stem

- (1) Transport of water & minerals from root to leaf through xylem
- (2) Bear leaf/flower/fruit/axillary bud/branch
- (3) Storage of food
eg: potato, onion, garlic, zaminkind, ginger, calocasia, turmeric
- (4) Support the plant
↳ Axillary bud modified into tendrils to climb around support
eg: watermelon, pumpkin, cucumber

(5) Transport of food (photosynthesis) from leaf to root through phloem.

(6) protection to plant

↳ Axillary bud modified into thorns to protect the plant from herbivores.

ex: citrus, wood apple, baugeinvilla

(7) Vegetative propagation (reproduction)

↳ grass, water hyacinth, mint, strawberry, banana etc.

* Arrangement

Base (old) to tip (new) $\Rightarrow$ Acropetal succession (order)

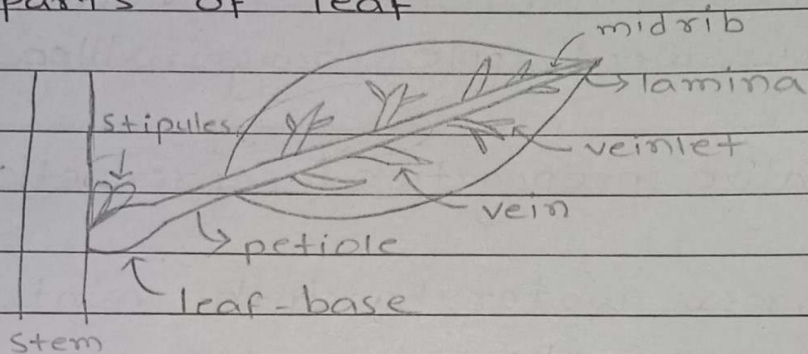
Tip (old) to base (new) $\Rightarrow$ Basipetal order

* Leaf

- Arise from node and lateral in position
- flat structure, green & photosynthetic
- They are arranged in acropetal order

- From axile of leaf and stem, axillary bud is present (It forms new branches, flower, tendril, thorn, new plant)

* 3- parts of leaf



- Midrib is extension of petiole
- Midrib is divided into vein and vein divided into veinlet
- Midrib, vein and veinlet have vascular bundle
- Stipules: Small leaf like structure at leaf base in some plant.
eg: china-rose

(1) Leaf-base

→ Base part

- Attached Attach. the leaf at node of stem
- In monocot (grass, wheat etc) the leaf-base is sheathy and cover the hollow stem partially or fully.

- In dicot (eg: pulses) the leaf-base is pulvinous /swollen

(2) petiole

- middle part, moderate - hard for support, helps in fluttering of leaf under wind, orient towards light source.

(3) Lamina

- Expanded, flat, photosynthetic
- It has midrib (largest v.B), vein (moderate size of v.B) and veinlet (smallest v.B)
- Midrib }
vein } (1) Transport of water minerals & foods
veinlet } (2) provide rigidity to the lamina

* phyllotaxy

- Arrangement of leaves on stem and branch is called phyllotaxy.

- There are three types of arrangement of leaf

(1) Alternate phyllotaxy

- One leaf from each node in alternate manner.

eg: China-rose, mustard, sunflower

(2) Opposite phyllotaxy

- Two leaves from each node in opposite manner.

ex: calotropis(AAK), Guava

(3) Whorled phyllotaxy

- Many leaves arise from each node in whorled manner

ex: Alstonia

* Venation

Arrangement of vein and veinlet in lamina is called venation

- There are two types of venation

(1) parallel-venation (2) Reticulate-venation

- equal size of vascular bundle unequal size of vascular bundle

ex: wheat

ex: china-rose

- When all vein run parallel to each other vein and veinlet form are called parallel venation
- In reticulate-venation network like structure

In dicot leaf

- In monocot leaf

* Types of leaf

• Simple leaf

Leaf which has one leaf base, one petiole and one lamina is called simple leaf
eg: mango, china-rose

• Simple leaf is entire (without incision) or incision along the margin of leaf (but not touch the midrib)

• Compound

• Compound leaf has one leaf base, one petiole and many leaflet

• In compound leaf midrib is called rachis.

• There are two types of compound leaf

(1) Pinnately compound leaf

Leaflet arranged on midrib (rachis) or incision up rachis

ex: Neem

(2) Palmately compound leaf

• Arrangement of leaflet at tip of petiole

ex: sitl sitl

note: There is no axillary bud near leaflet but near petiole.

* Inflorescence

- Arrangement of flower on floral axis (stem/branch) is called inflorescence
- There are two types of inflorescence

(1) Cymose

(2) Racemose

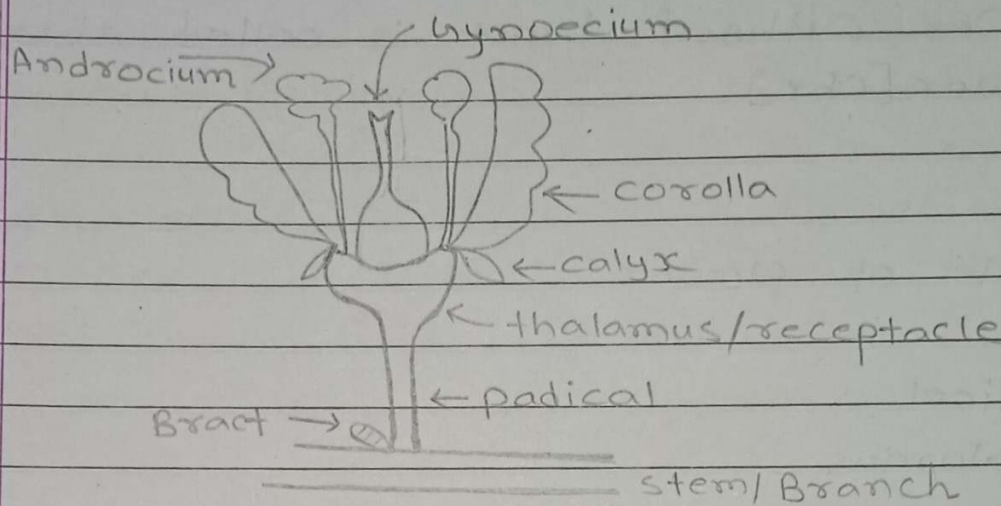
- Terminal bud form first. Only axillary buds flower so there is no form flowers so terminal growth of axis of plant but continue axis growth (limited growth) and then axillary bud form. Racemose is acropetal because old flower is below and new is above.
- * other flowers
- cymose is basipetal because old flower (bloomed). In racemose there is is above and new is below. no flower form on terminal bud

Short plant

• long plant

* Flower

- Reproductive part of angiosperms.
- It is modification of shoot (stem + leaf)



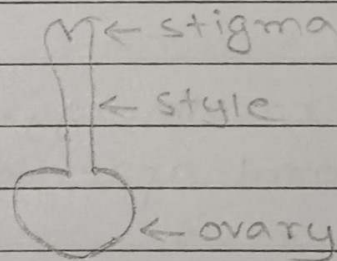
- Stem/branch modified and form ~~the~~ pedicel and thalamus, thalamus has node, inter node
- From node of thalamus calyx, corolla, androecium and gynoecium arise which is modification of leaf
- Calyx, corolla, gynoecium and androecium are floral appendages of flower.
- Corolla is colorful part of flower
- Bract ÷ Small leaf like structure at the base of pedicel.

- flower with bract is called bracteated flower (Br)
- flower without bract is called ebracteated flower [Ebr]

* Parts of flower

- (1) Pedicel
- (2) Thalamus
- (3) Calyx
- (4) Corolla
- (5) Androecium (♂ - reproductive organ)
- (6) Gynoecium (♀ - reproductive organ)

style ← → stigma
 ↓
 ovary



- single member of androecium → stamen
- single member of gynoecium → carpel/pistil

* Sexuality of flower

Bisexual-flower

or

Monoecious

- flower with both androecium and gymnoecium

Unisexual - flower

or

Dioecious

- flower with only androecium or only gymnoecium

Unisexual flower

Male-flower

or

Staminate flower

- have only androecium

Female-flower

or

pistillate flower

- have only gymnoecium

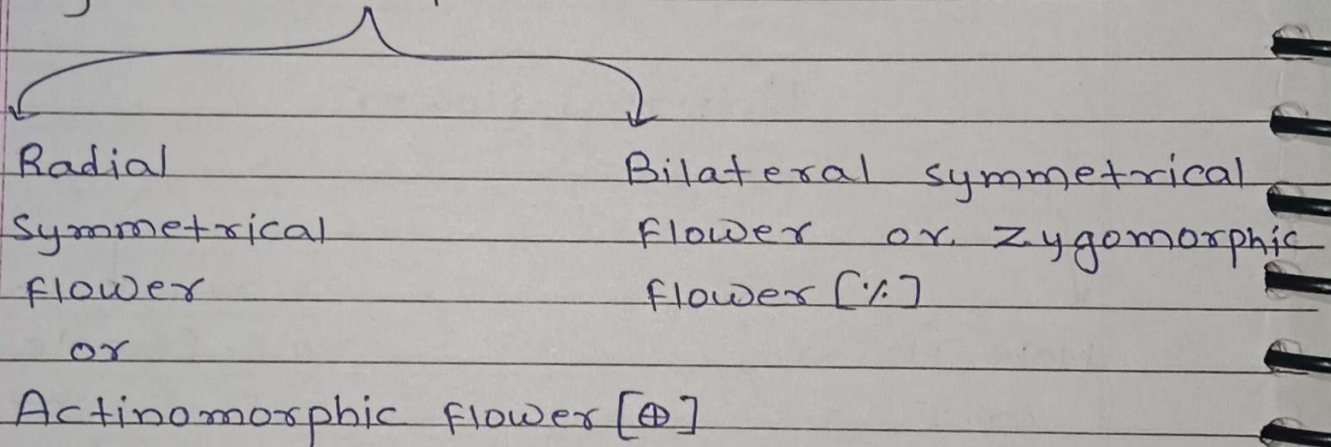
- Staminode flower

Male flower which is sterile/intertile
(no formation of pollen-grains)

* Symmetry and Asymmetry

- Symmetry
which can divide into two equal halves
- Asymmetry
which can not divide into two equal halves

* Symmetrical flower



• Radial symmetrical flower

The flower which can divide into two equal halves by cutting both horizontally and vertically and must be going through the centre.

eg: Mustard, Datura, chilly

- Bilateral symmetrical flower

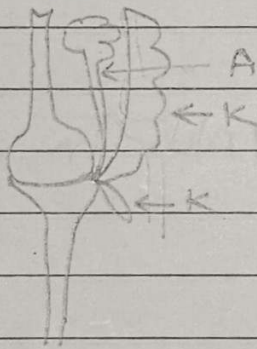
The flower which can divide into two equal halves by cutting vertically only and must be going through the centre.

- ✱ Asymmetrical flower

The flower which can't divide into two equal halves.

- ✱ position of ovary with respect to K/C/A

(1) Hypogynous

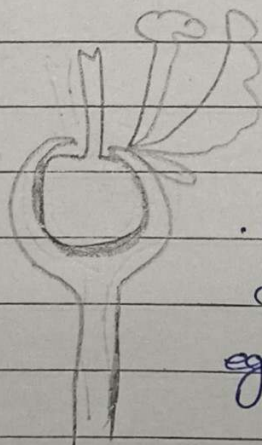


- Superior ovary (ᳵ)

- A, C, K is below the ovary

eg: Mustard, china-rose, brinjal

(2) Epigynous



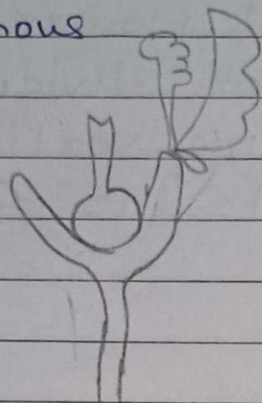
- Inferior ovary (ᳶ)

- A, C, K is above the ovary

- Cup like thalamus fully cover the ovary

eg: Cucumber, sunflower, guava

(3) Parigynous



- Half superior - half inferior ovary [G-]

- Half cup shape thalamus which cover half part of ovary.

eg: Rose, plum, peach

* Trimerous flower

- flower which have $K/C/A/G$ in multiple of three in number
- In monocot

* Tetramerous flower

flower which have $K/C/A/G$ in multiple of four

- In dicot

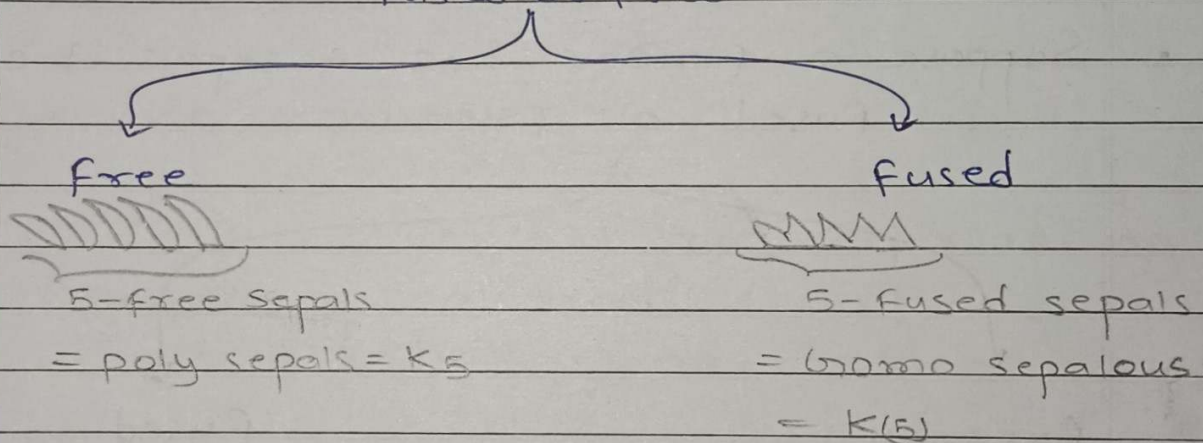
* Pentamerous flower

- flower which have $K/C/A/G$ in multiple of five.

- In dicot

* Calyx [K]

- 1st outermost whorl of flower
- A single member of calyx is called sepal
- Green in color, photosynthetic, flattened leaf like
- Calyx provide protection to the bud (young flower)
- Suppose a flower has 5-sepals it can be :-
fused or free

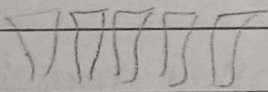


- Some fruit has calyx is called persistent calyx
eg: Tomato, brinjal, chilly

* Corolla

- 2nd whorl of flower
- Each member (unit) is called petal
- It is coloured, scented and ^{have} nectar (sweet carbohydrate)
- Colour of flower depend on colour of corolla
- Colour, scent and nectar of corolla attract insects.
- Night Blooming flower generally colourless, but scented (to attract insects in night)
- Suppose a flower has 5 sepals it can be fused or free

free

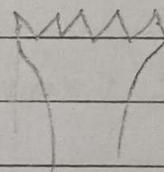


↳ 5-free petals

= polypetalous

= C₅

fused



↳ 5-fused petals

= gamopetalous

= C₍₅₎

- Shape of gamopetalous can be tubular, Ball, barrel, funnel.

* Perianth (p)

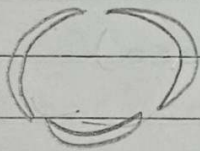
- When we can not differentiate calyx and corolla because of their similar shape, size and colour, they together called perianth.

• unit of perianth $\rightarrow$ Tepal / phyll

* Aestivation

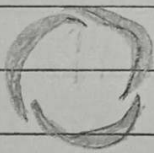
- Arrangement of calyx/sepal and corolla/petals on thalamus

(1) Valvate aestivation



- close but not - overlapping
- eg: calotropis
- Radial symmetrical

(2) Twisted aestivation



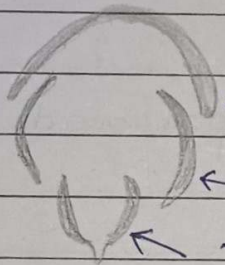
- All overlapping in specific direction
- Radial symmetrical
- eg: cotton plant, Lady's finger, china-rose

(3) Imbricate aestivation



- Overlapping not in particular direction
- eg: Cassia, culmohar

(4) vexillary aestivation or papilionaceous [1 + 2 + (2)]

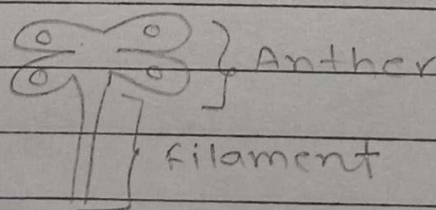


- for petals (corolla) only
- large posterior petal = standard
- 2 medium size free petals = wings
- 2 - inner small size fused petals = Keels
- Bilateral symmetrical
- ex: pulses (pea, bean)

* Androecium

3rd whorl of flower, ♂ reproductive organ.

- unit - Stamen (A single member)



- Anther is bilobed
- Each ~~top~~ lob has two pollen chamber
Pollen chamber contain pollen grains.
- Filament is attached to the thalamus
- Androecium (stamens) may attach with corolla or perianth (tepals)

[$\overline{CA}$]

Epipetalous

Attachement of stamens with petal/corolla

eg: Brinjal

[$\overline{PA}$] $\rightarrow$ Epiphyllous

Attachement of stamens with tepals. ~~peni~~

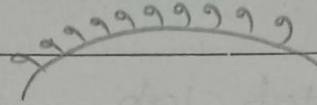
eg: Lily

- Stamens attach together and form Delphus (Bundle of fused stamens)
- There are three types of delphous
 - (1) Monodelphous
 - (2) Diadelphous
 - (3) polyadelphous

- Monoadelphous

- one delphous

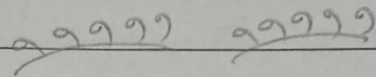
- eg: china-rose



- Diadelphous

- Two delphous

- eg: pulses (pea)

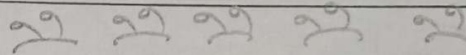


$\rightarrow (9) + 1$

- Polyadelphous

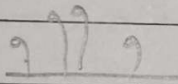
- many delphous

- eg: citrus, Lemon

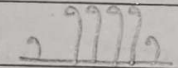


- Length of stamens can different in some plant

- eg: calvia



- Mustard



[Anatomy of flowering plant]

Page No.:

Date: / /

* Introduction

- Study of internal structure of flowering plant (angiosperm) is known as anatomy of flowering plant.
- Angiosperm include monocot and dicot

* Tissue

A group of many cells having common function and origin.

* Animals and plants

Animals

plants

- | | |
|---|--|
| <ul style="list-style-type: none">• No meristems, due to absence of it, growth continue upto a certain age of life (determinate growth)• Tissue, organ, organ system | <ul style="list-style-type: none">• Meristems is present, due to it growth continue throughout the life (Indeterminate growth)• Tissue, organ (root, stem and leaf), tissue system, no organ system |
|---|--|

* plant tissue

→ two types

(1) Meristematic tissue (MT)

→ for growth, undifferentiated

(2) permanent tissue

→ perform work, differentiated

* Meristematic tissue (MT)

→ Two types

(1) primary MT (2) Secondary MT

* primary meristematic tissue

• Start dividing from beginning (from embryo)

eg: Root apex, shoot apex, axillary bud,

Intercalary meristem, Intra-fascic fascicular
/vascular-cambium

• primary meristematic tissue form new cells,
new cells differentiate into primary tissues
and then primary tissues convert into
primary organ (Root, stem and leaf)

- Primary MT perform primary growth in all plants (Herbs, shrubs and trees)
- Primary growth $\div$ increase in length of stem, root and leaf.

* Secondary meristematic tissue

- When permanent tissue is converted into meristematic tissue by the process of dedifferentiation called secondary meristematic tissue eg: Inter fascicular cambium, cork cambium.
- Secondary MT form new cells, new cells redifferentiated into secondary tissues which increase diameter of stem and root in only trees.
- Secondary MT is present in ~~only trees~~ some dicot and gymnosperms.
- Secondary MT perform secondary growth.
- Secondary growth $\div$ Increase in diameter of plant

* permanent tissue

→ Two types

(1) Simple permanent tissue

• Made of a single type of cells.

eg: parenchyma tissue, collenchyma tissue and sclerenchyma tissue.

(2) Complex permanent tissue

• made of many different types of cells.

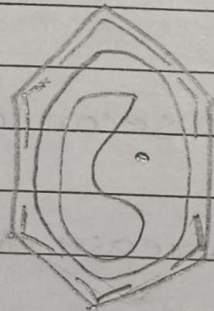
eg: Xylem, phloem

• Xylem and phloem is made of four types of cells.

* parenchyma cell

→ soft cell, live cell

→ Also known as mother cell.



* Collenchyma

→ live cell, moderate hard



- extra deposition of cellulose + hemicellulose + pectin on secondary wall at corners of the cell.

* Sclerenchyma

→ very hard, dead cell



- extra deposition of lignin - chemical (very hard and impermeable for water) uniformly throughout the cells. finally cell become without protoplast and die
- If sclerenchyma cell is very long it is called sclerenchyma - fibre.
- If sclerenchyma cell is short it is called sclerenchyma sclereid.

* Xylem tissue

→ Made of four types of cells

(1) Xylem ~~par~~ parenchyma

→ storage in function, live cell

(2) Xylem-fibre

→ mechanical support (gives strength)

→ very hard, dead cell

(3) Xylem tracheid

→ Transport of water and minerals

→ dead cell

→ Tube of single cell.

(4) Xylem-vessels

→ Tube of many cells, dead cell

* phloem tissue

• Made of four types of cells

(1) phloem-parenchyma

→ storage of food

→ live cell

(2) phloem-fibre

→ mechanical support

→ softer than xylem-fibre

→ dead cell

(3) Companion cell

→ Helps the sieve-tube

→ live cell

(4) Sieve cell/sieve tube

→ Transport of food, live cell

* Vascular plant

pteridophytes, gymnosperms, angiosperms

* pteridophytes and gymnosperms

- Xylem

→ Xylem vessel is absent

→ Water and minerals are transported by xylem tracheid

- phloem

→ No sieve-tube and companion cell

→ food is transported by sieve cell

- In only gymnosperm sieve cell is help by albuminous cells.

* Angiosperms

- Xylem of monocot and dicot

→ All four component are present

→ Water is transported by vessels and tracheid.

- phloem of dicot

→ All four component is present

→ food is transported by sieve cell and sieve tube.

- phloem of monocot

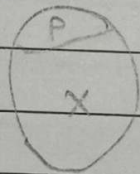
→ All ~~four~~ component is present except phloem - parenchyma cell.

→ food is transported by sieve cell and sieve tube.

* Vascular tissue (xylem & phloem) of angiosperm

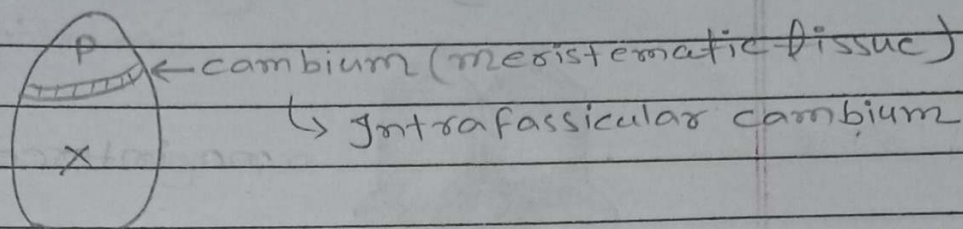
- Amount of xylem is more than phloem

- V.B of monocot



→ closed type, V.B without cambium, no secondary growth.

• V.B of dicot

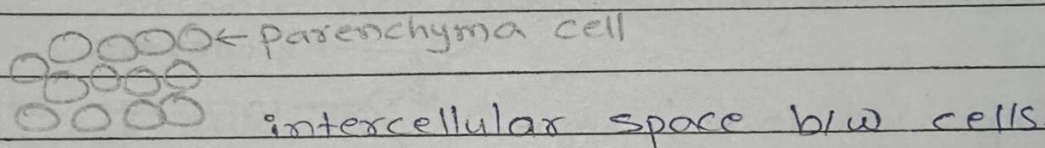


→ open type, v.B with cambium, secondary growth

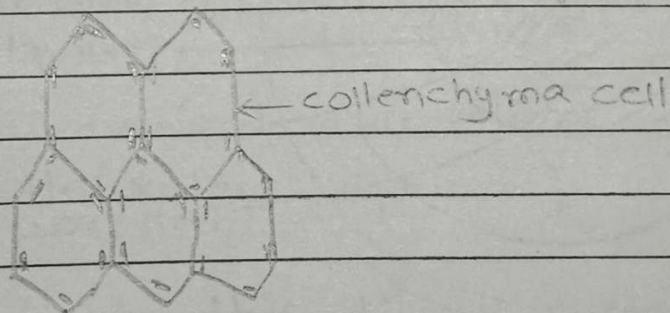
* Sieve tube and companion cell

- Sieve tube cells are living and annucleated
- Companion cell is living and nucleated

* parenchyma tissue

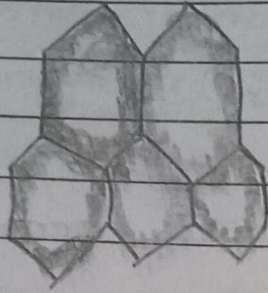


* Collenchyma tissue



no intercellular space b/w cells

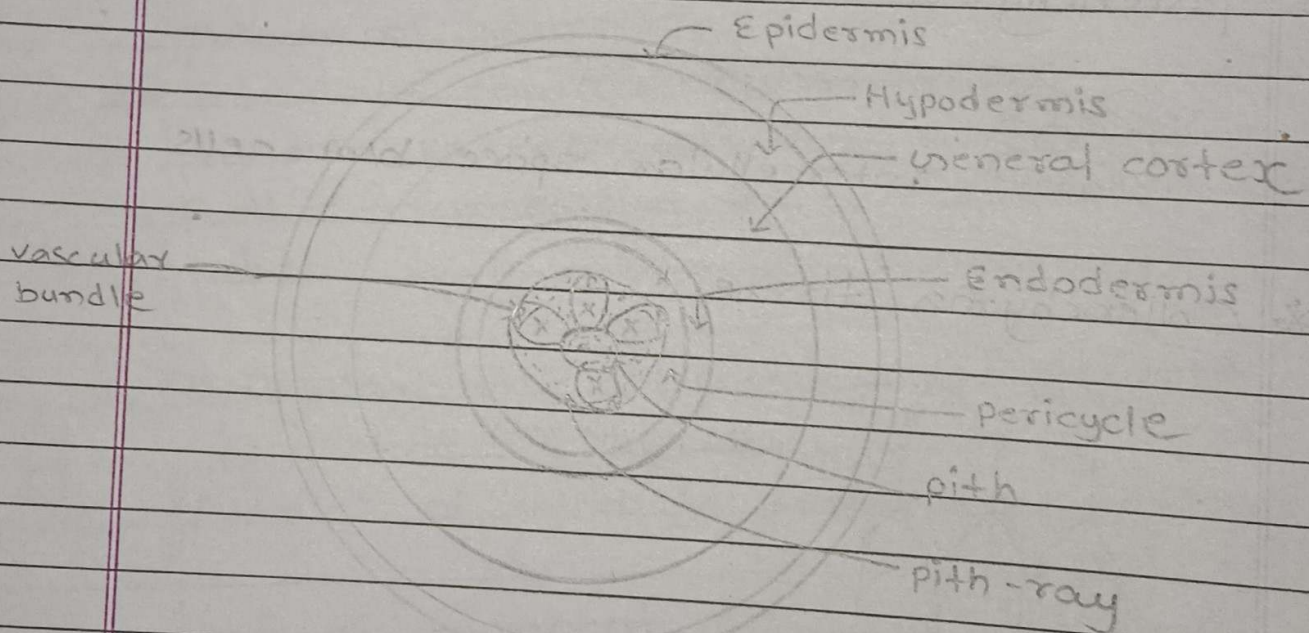
* Sclerenchyma tissue



no intercellular space

* Tissue system of angiosperm

→ Three types of tissue system is present in all organ (stem, root and leaf) of angiosperm.



- Xylem is towards pith and phloem is away from pith

(1) Epidermal tissue system includes: Epidermis

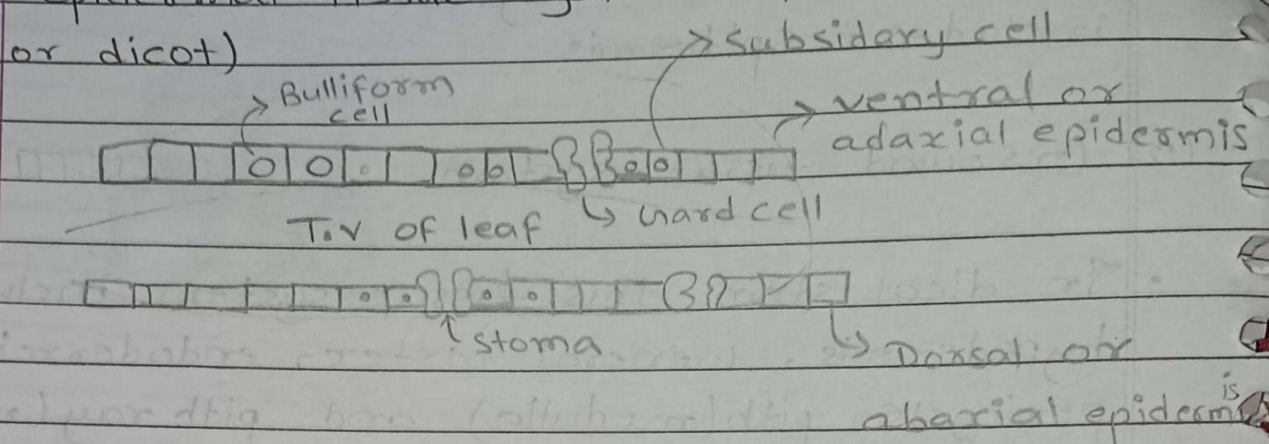
(2) Ground tissue system

- In dicot stem this tissue system includes hypodermis, general cortex, endodermis, pericycle, pith (medulla) and pith ray (medullary ray)
- In monocot stem this tissue system includes hypodermis and general cortex
- In root (monocot or dicot) hypodermis is absent
- In leaf this tissue system includes green mesophyll cells (parenchyma cells with chloroplast)

(3) Vascular tissue system

- In monocot this tissue system includes vascular bundle (xylem + phloem)
- In dicot this tissue system includes vascular bundle + cambium (in stem)

* Epidermal tissue system of leaf (monocot or dicot)



- Many subsidiary cells + stoma + guard cells (2) $\Rightarrow$ stomatal apparatus

- stoma $\div$ Empty space b/w two guard cells

• Subsidiary cell $\div$ helps the guard cells.

- In ~~monocot~~ monocot leaf the shape of guard cell is dumbbell

- In dicot leaf the shape of guard cell is kidney or bean shape

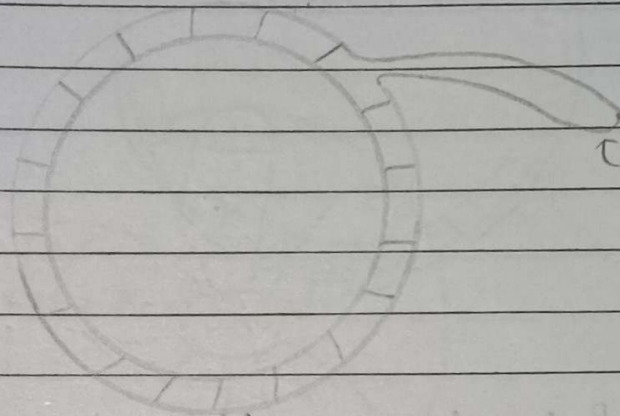
- Bulliform cells are present on adaxial of leaf of grasses.

- function of bulliform cells

(i) Curling/rolling of leaf in dry condition in soil to reduce surface area (to reduce water loss/transpiration)

(ii) Expansion of leaf when water is available in soil.

* Epidermal tissue system of root (monocot & dicot)

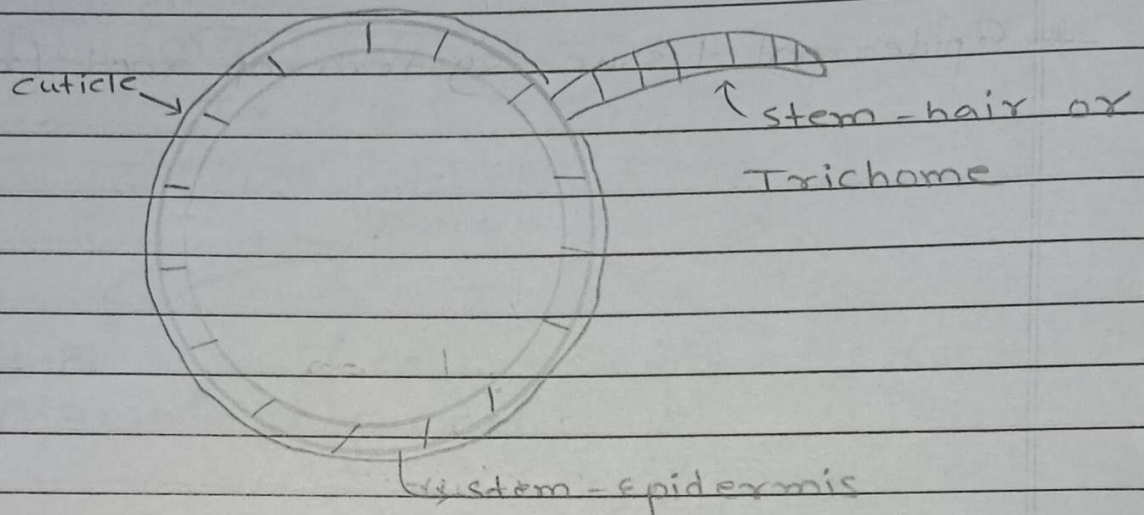


Root hair or
Epiblemal hair

Root - Epidermis or Epiblema

- Root hair is extension of epidermal cell of root.
- Root hair is unicellular in structure.
- Root hair increase surface-area of root to absorb more and more water and nutrients from the soil.

* Epidermal tissue system of stem (monocot & Dicot)

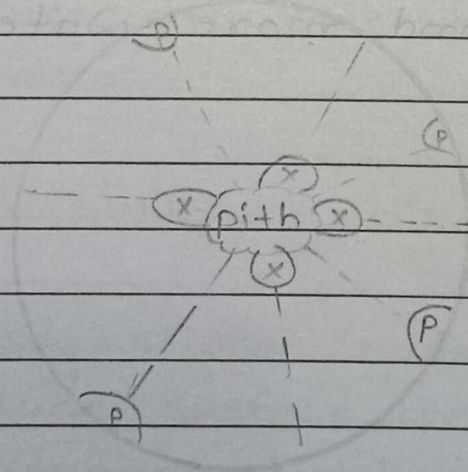


• Stem hair is multicellular structure

• function of stem hair :-

- (i) It secrete some chemicals
- (ii) It prevents the dry air to come in contact with stem / It reduce water-loss from stem

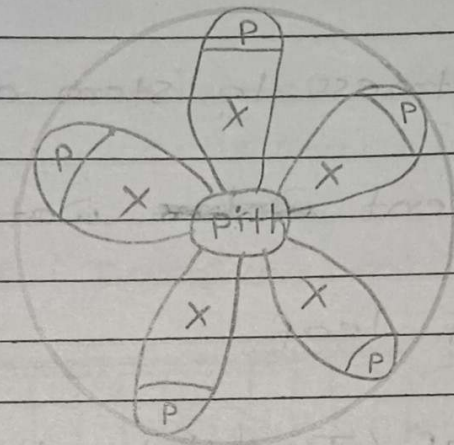
* Vascular tissue system of root (monocot & Dicot)



- Vascular bundle of root is called radial v.B.

- Xylem and phloem as separate path patches and they are present at different radius.

- * Vascular tissue system of stem or leaf (monocot & dicot)



- The v.B of stem and leaf is also known as conjoint (collateral) v.B.
- Xylem and phloem are jointed together and they are at same radius
- In vascular bundle of stem of dicot, cambium is present.
- The vascular bundle with cambium is called conjoint closed vascular bundle (stem of dicot)

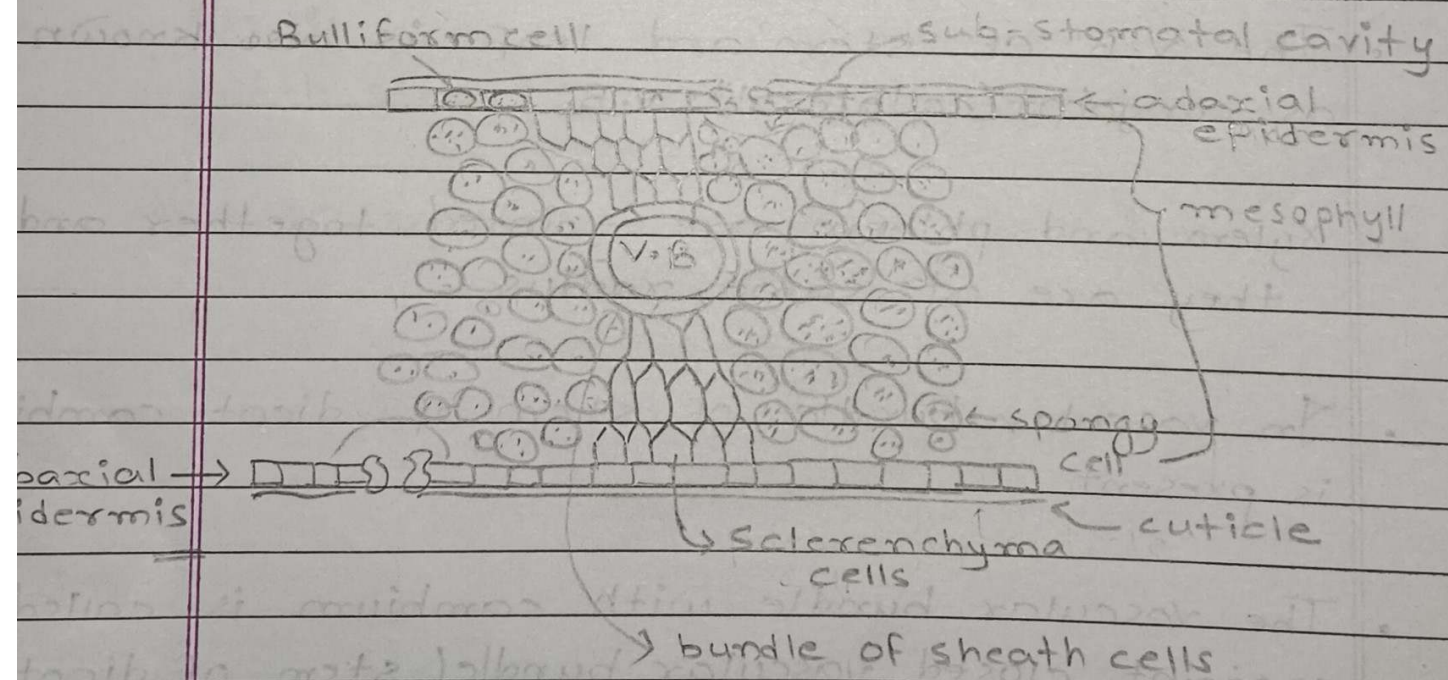
- Vascular bundle with cambium is called conjoint open vascular bundle.

* Cuticle

- Over epidermal tissue system (epidermis) of stem and leaf a waxy layer is present called cuticle.
- provide brightness to stem and leaf
- Cuticle prevent ~~water~~ water loss

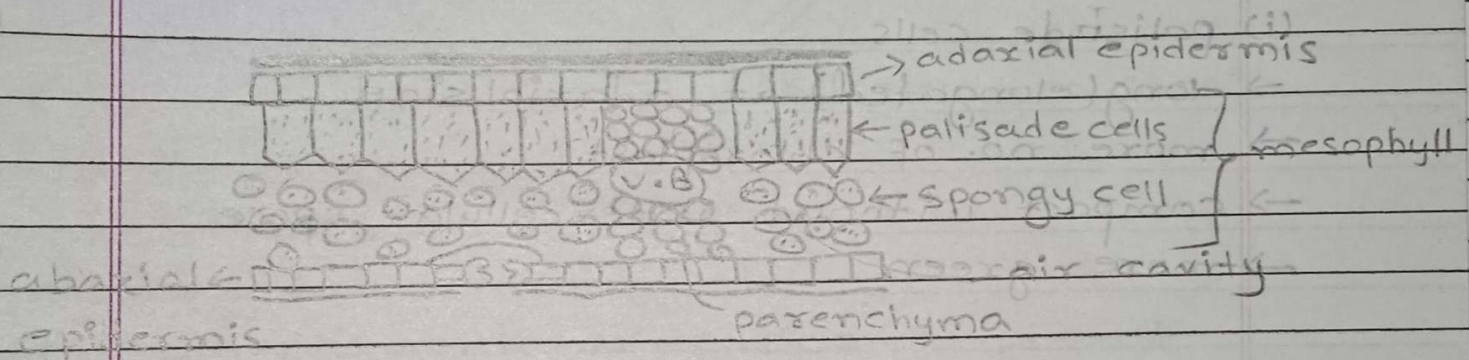
* Anatomy of leaf

(1) Monocot leaf (Isobilateral leaf)



- Equal thickness of cuticle, equal number of stomata, equal greenness
- Bulliform cells are present at adaxial surface in some monocot (eg. grasses)
- V.B is supported by ~~seta~~ sclerenchyma cells of
- Mesophyll is made of single type of cells called spongy cells (round or oval shape)

(2) Dicot leaf (Dorsiventral leaf)



- Adaxial cuticle is more thicker than abaxial cuticle
- Stomata is absent or few in number in upper epidermis.
- Stomata is present in lower epidermis.

- Adaxial surface is more green due to palisade cells.
- Abaxial surface is less green due to spongy cells.
- Bulliform cells is absent
- V.B is supported by parenchyma cells
- Mesophyll is made of two types of cells.

(i) palisade cells

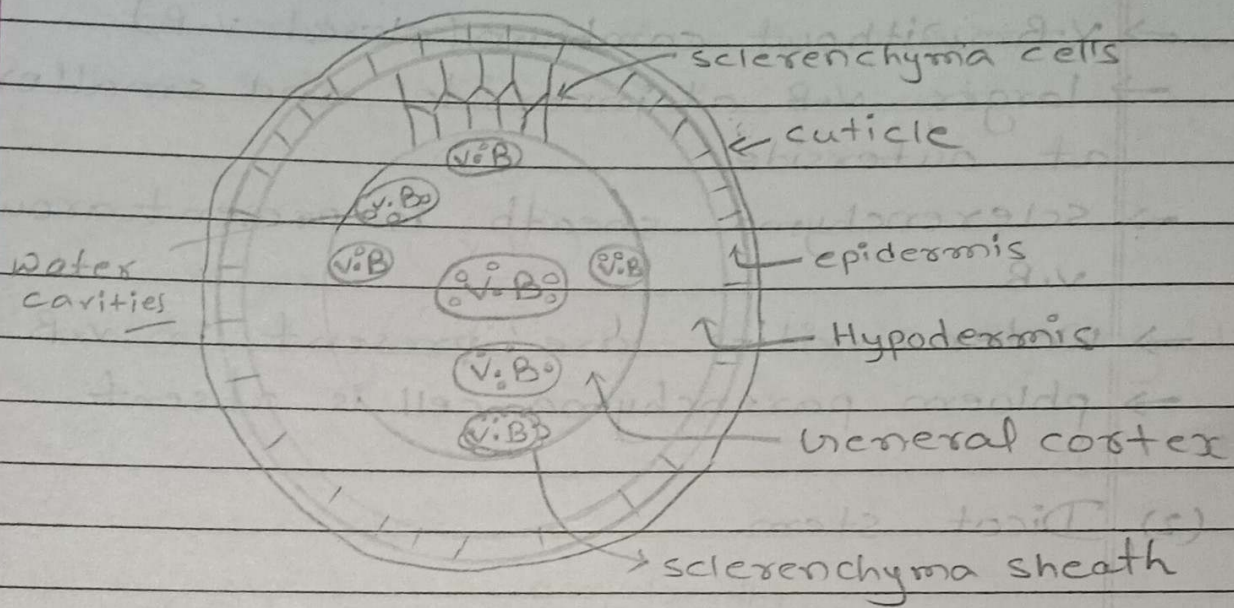
- long (elongated) at adaxial side
- more no. of chloroplast
- compact without intercellular space
- more green

(ii) Spongy cells

- oval/round shape at abaxial side
- less no. of chloroplast
- less green
- loosely arranged cells with large air-space or cavity

A Anatomy of stem

(1) Monocot stem



• Epidermis

- single layer, compact
- over the epidermis cuticle is present
- made of parenchyma cell

• Hypodermis

- few layers (2 to 3)
- made of sclerenchyma cells

• General cortex

- many layer
- made of parenchyma cells with intercellular space.

→ V.B are scattered in general cortex

• V.B

→ conjoint

→ V.B without cambium (closed V.B)

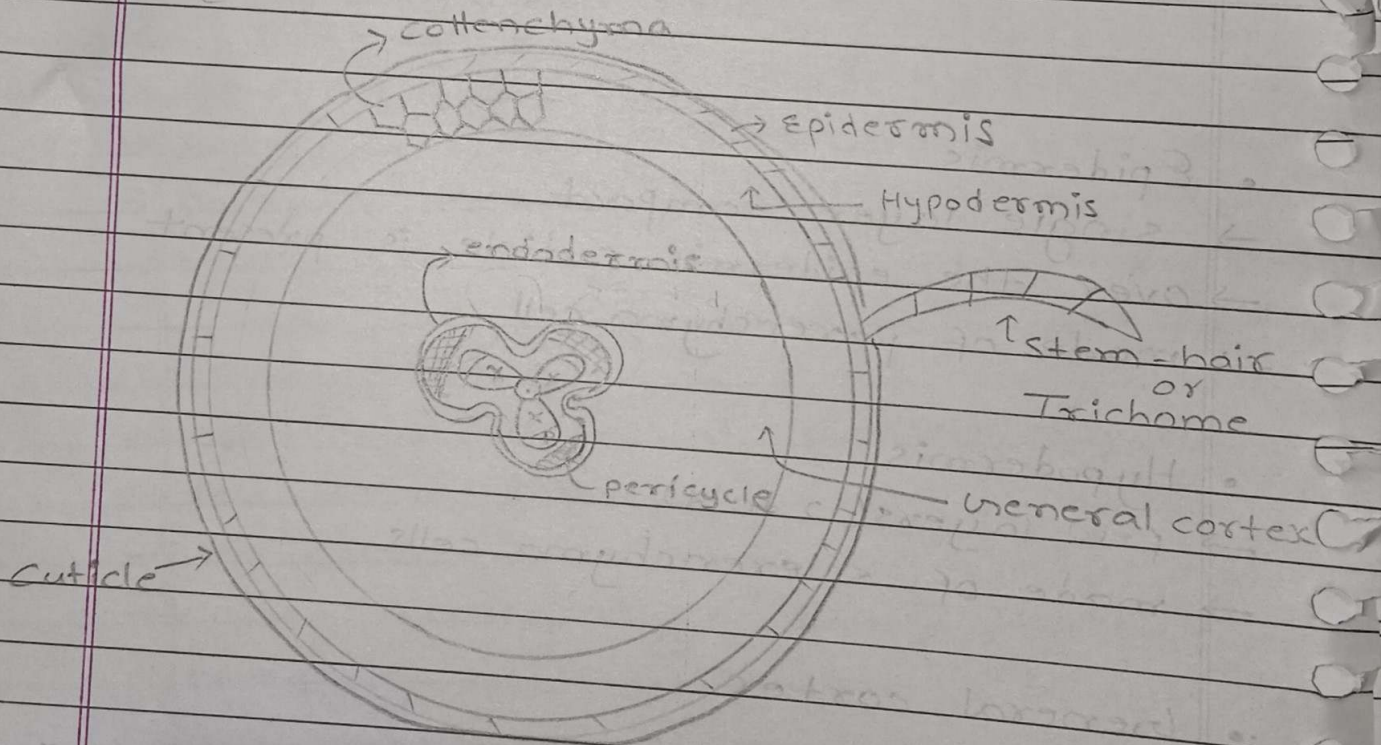
→ larger V.B at inner side and smaller V.B at outer side

→ Sclerenchyma sheath is present around V.B

→ Water cavities are present in V.B

→ phloem parenchyma cell is absent.

(2) Dicot stem



- Epidermis

- single layer

- made of parenchyma cells which is compactly arranged

- Over epidermis cuticle is present

- stem hair (Trichome) is present

- Hypodermis

- few layers

- made of green collenchyma (in young dicot stem)

- General cortex

- many layers

- made of parenchyma cells which is loosely arranged

- Endodermis

- single layer

- made of parenchyma cells which is compactly arranged

- Also known as starch-sheath because cells of it store starch

- Pericycle

- ~~many~~ many layers (2 to 5)

- Discontinuous, semi lunar shaped

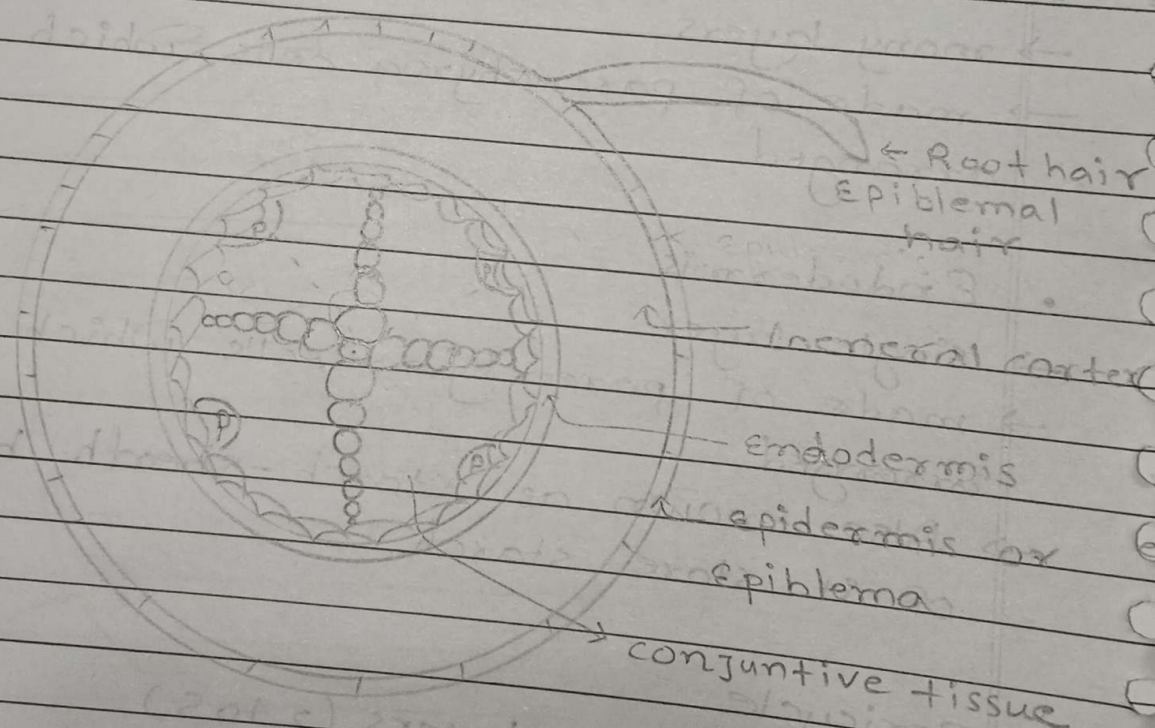
- made of sclerenchyma cells.

- pith (medulla)
- A central part
- made of parenchyma cells which is loosely arranged with large intercellular space

- pith ray (medullary ray)
- Extensions of parenchyma cells of pith b/w two vascular bundles

* Anatomy of root

(1) Dicot root



Usually 4 patches of xylem and phloem is found in root of dicot

• Epidermis

→ Single layer

→ made of parenchyma cells which is compactly arranged.

→ Some cells of epidermis extend outside and form root hair.

→ No cuticle on epidermis

• General cortex

→ many layers

→ made of parenchyma cells which is loosely arranged with intercellular space.

• Endodermis

→ single layer

→ made of parenchyma cells which is compactly arranged

→ Casparian-stripe is present in the walls of cells of endodermis.

• Pericycle

→ few layers

→ made of parenchyma cells

• Pith

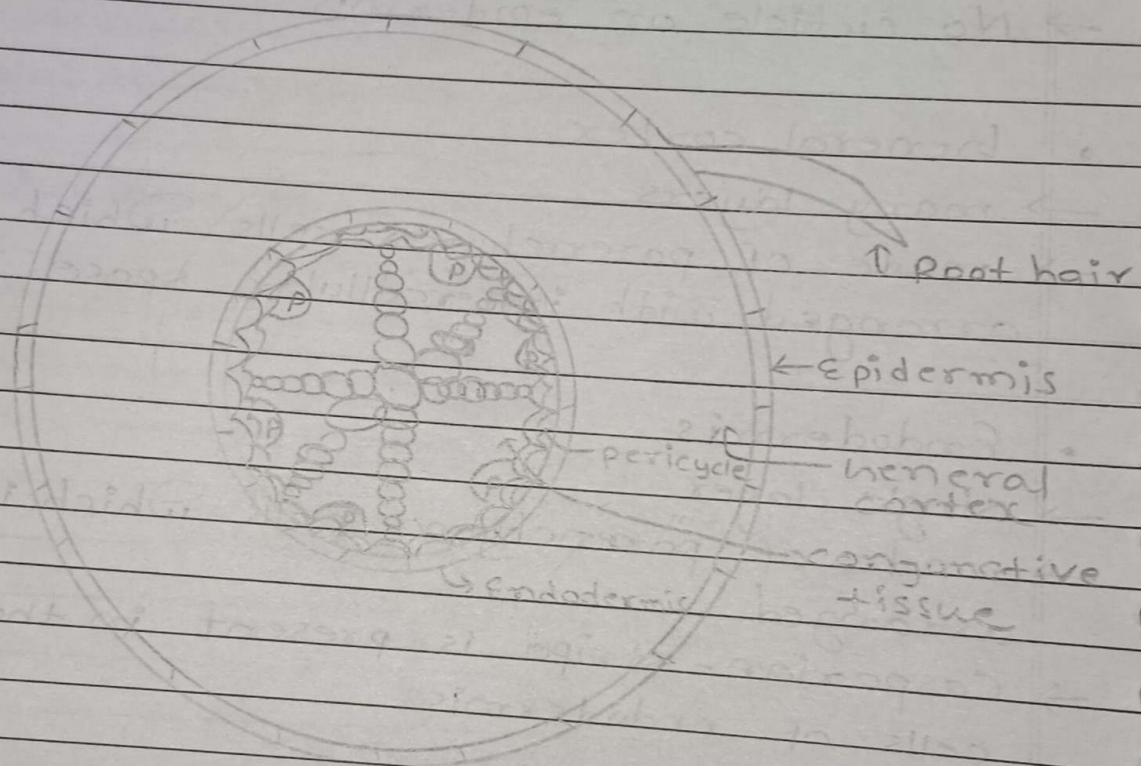
→ small and inconspicuous

→ made of parenchyma cells which is loosely arranged with large intercellular space

- Conjunctive tissue

- present b/w xylem and phloem
- made of parenchyma cells

(2) Monocot root



- Usually 6 patches of xylem and phloem is found in root of monocot

- Epidermis

→ Same as dicot root

- General cortex

→ Same as dicot root but the general cortex of monocot is large than dicot root

- Endodermis

→ Same as dicot root

- Pericycle

→ Same as dicot root

- Pith

→ large and conspicuous

→ made of parenchyma cells which is loosely arranged with large intercellular space

- Conjunctive tissue

→ Same as dicot root

- Intercalary meristem is found in internode of some monocot (eg: grasses) which help the plant to quickly elongate (grow) after being grazed or cut